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THE HIPPOBOSCIDAE OR LOUSE-FLIES (DIPTERA) OF MAMMALS AND BIRDS

PART II. TAXONOMY, EVOLUTION AND REVISION OF AMERICAN GENERA AND SPECIES

BY JOSEPH C. BEQUAERT

ALEXANDER AGASSIZ PROFESSOR OF ZOOLOGY
MUSEUM OF COMPARATIVE ZOOLOGY AT HARVARD COLLEGE,
CAMBRIDGE, MASSACHUSETTS

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Ceronia "Leach" E. Blanchard, 1840, Hist. Nat. Insectes, **3**, p. 631 (misspelling of *Feronia;* in synonymy of *Olfersia*).

Olfersia Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 605 (substitute name for *Feronia* Leach, 1817, including Leach's three species). Type by designation of Speiser, 1899, Wien. Entom. Zeitg., **18**, p. 202: *Feronia spinifera* Leach, 1817.

Pseudolfersia Coquillett, 1899, Canad. Entom., **31**, p. 336 (monotypic for *Pseudolfersia maculata* Coquillett, 1899 = *Lynchia fumipennis* Sahlberg, 1886).

Psuedolfersia Washburn, 1905, 10th Ann. Rept. State Entom. Minnesota, p. 159 (misspelling of *Pseudolfersia;* in the combination *Psuedolfersia maculata* Coquillett).

Pseudoolfersia Vogelsang, 1936, Rev. de la Policlinica, Caracas, **6**, No. 31, p. 2. 123 (in the combination *Pseudoolfersia vulturis* v. d. Wulp = *Olfersia bisulcata* Macquart).

Generic Characters. Permanently fully-winged flies, parasitic of birds. Medium-sized and robust; head and thorax strongly flattened. Head very flat, large, slightly wider than high, transversely elliptical, inserted in the broadly concave and trisinuate anterior margin of prescutum. Ocelli absent. Eyes large, mostly dorsal, bordered along the outer orbits (ventrally) by a narrow, blunt rim, of many superficially divided, minute ommatidia (almost obliterated in *O. sordida*). Upper orbit distinct, often very long. Postvertex and frons of about equal length, meeting or nearly meeting at ptilinal suture; mediovertex either absent or reduced to small triangles at lower sides of postvertex. Occipital margin convex, often partly overlapping anterior margin of prescutum, sometimes produced behind and separated by broad notches from upper orbits. Frons (Figs. 84*A–D*) large, of a single flattened sclerite in which lunula is in most species completely fused with interantennal area (or frontal carina); position of lunula marked only by a median pit or (in *O. bisulcata* and *O. fumipennis*) by short traces of sutures at the antennae; frontal carina very wide, its anterior $\frac{1}{2}$ to $\frac{2}{3}$ divided by a narrow median,

[59] Coquillett states that Speiser designated the type of *Feronia* in 1899, but this is not strictly correct. Speiser gave "*Feronia spinifera*" as the type of *Olfersia* and did not cite *Feronia* as a synonym of *Olfersia.*

longitudinal slit into flattened, partly rugulose areas corresponding to the apical arms of other Ornithomyiinae; the diverging apices very short and broadly triangular. Antennal pits far apart, each completely surrounded by a rim. Postvertex without pit, either forming one smooth, flat sclerite (*O. sordida*) or partly divided by a superficial, transverse, curved depression into an upper smooth and a lower dull area (the latter more or less alutaceous, owing to a microscopic maze or mosaic of very fine impressed lines). Antennae medium-sized, mostly or entirely contained within the antennal pits; 1st segment large, flat, distinct from the 2nd, completely or partly separated by a basal suture from the sides of the lunula; appendage of 2nd segment short and narrow, not or barely reaching the diverging apices of frons; arista of 3rd segment with a thick basal and a finely divided apical portion. Palpi well developed. Thorax (Fig. 89*A*) strongly depressed. Protergum very short, hidden by the occipital margin. Humeral callosities prominent, conical, straight; posthumeral suture incomplete, deep and transverse posteriorly, not reaching anterior margin of prescutum. Prothoracic spiracle small, narrow, dorso-lateral in the notch between humeral callosity and anepisternum. Antero-median area of prescutum flat, its post-occipital margin trisinuate, being bluntly produced on either side of the median inward curve; transverse mesonotal suture near hind third of mesonotum, curved backward, and nearly complete, though often weak medially; postalar calli scarcely set off from disk of mesonotum; median notal suture an extremely fine line, sometimes indistinct; notopleuron completely fused with prescutum, its position indicated only by a projecting apical lobe usually bearing one, rarely two notopleural bristles (none in *O. sordida*). Dorsal aspect of anepisternum (Fig. 87*H*) narrow, lath-shaped, rather abruptly widened posteriorly into a broad, bluntly rounded or truncate, lateral protuberance, which slants downward and curves into the pleuron. Scutellum large, transversely rectangular, with nearly straight, blunt hind margin; its disk flat or slightly convex, without transverse or longitudinal depressions. Metanotal pleurotergite (Fig. 87*G*) retort-shaped, finely hairy, the long outer portion moderately swollen, ending inwardly (at the side of the scutellum) in a short, blunt, finger-shaped process directed backward and set off by a basal constriction. Sternum: suture between prosternum and mesosternum lacking; prosternum forming two broad lobes between fore coxae, the lobes evenly rounded anteriorly and separated by a wide, shallow inward curve; other transverse and longitudinal sutures

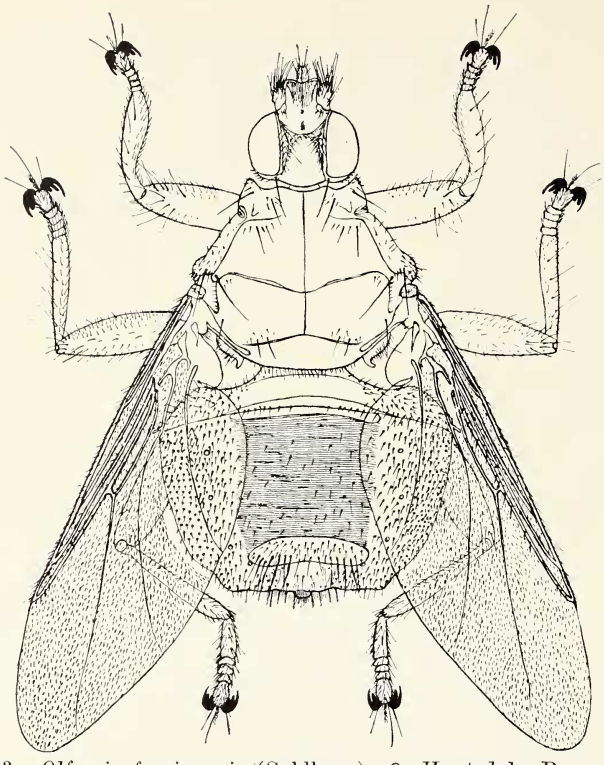

Fig. 83. *Olfersia fumipennis* (Sahlberg), ♀, Huntsdale, Pa., on *Pandion haliaetus carolinensis*. ×about 8.

either nearly complete or partly obliterated, sometimes superficial or indicated mainly at the furcal pits; no metasternal tooth over base of hind coxa; sutures of pleura mostly obliterated; anterior area of mesopleuron hollowed as a deep groove, slanting forward to receive the retracted fore femur. Metathoracic spiracle plainly visible at extreme lower edge of pleurotergite, close to and above insertion of hind coxa. Legs of the usual shape; femora moderately swollen; claws seemingly tridentate (Fig. 89*D*); tooth proper deeply bifid, with the inner branch particularly long and bluntly pointed; basal heel a flattened tooth.[60] Wing (Fig. 14*E*) func-

[60] Kieffer (1900, p. 338) grouped *Olfersia* with *Hippobosca* and *Melophagus* among the flies with so-called "split claws" (that is two-pronged, with a simple apical tooth and a basal heel only); but this is erroneous, as the claw of *Olfersia* is three-pronged, as in *Ornithomyia*.

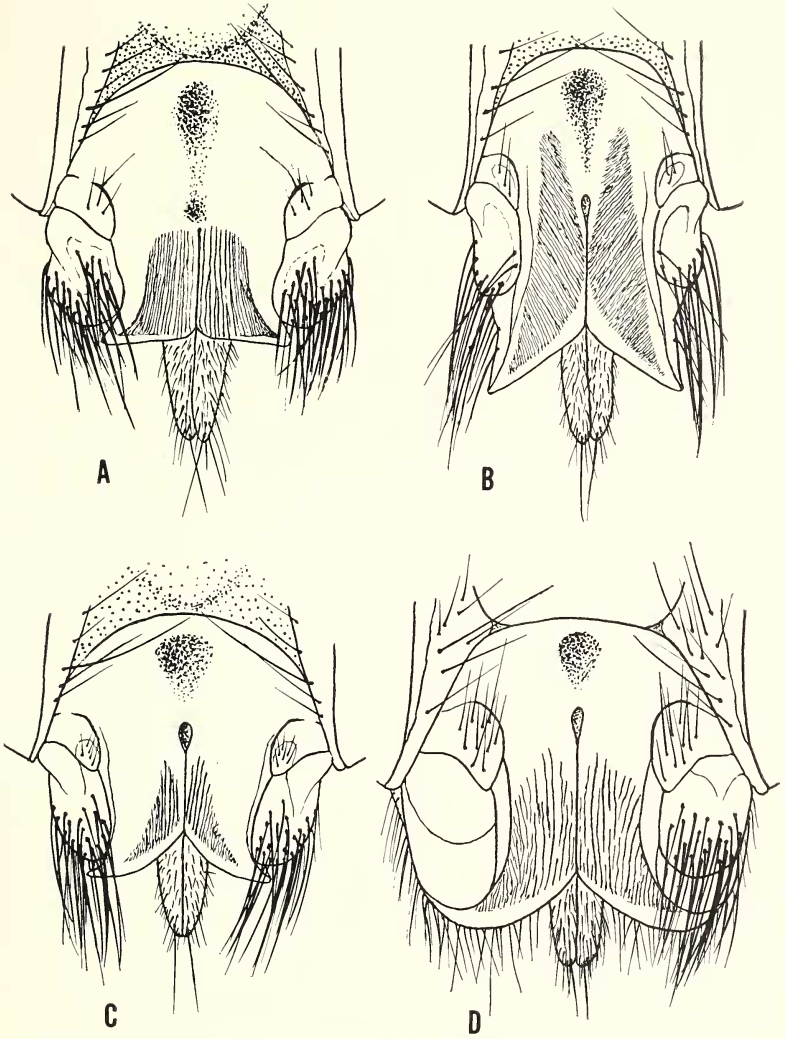

Fig. 84. Frontal area and antennae of *Olfersia;* **A**, *O. fumipennis* (Sahlberg), ♀, Huntsdale, on *Pandion haliaetus carolinensis;* **B**, *O. coriacea* van der Wulp, ♀, Gallon Jug, on *Agriocharis ocellata;* **C**, *O. aenescens* C.G. Thomson, ♀, Ascension I.; **D**, *O. sordida* Bigot, ♀, Trinidad, on *Pelecanus o. occidentalis,* with 2nd antennal segment removed on one side to show the pit.

tional throughout adult life, long and broad; venation essentially as in *Lynchia:* 6 distinct longitudinal veins beyond the subcosta, none of them confluent; subcosta reaching costa; only 2 cross-veins, the anterior and anterior basal; posterior basal cross-vein lost and true 6th longitudinal vein (*6* in Fig. 89*A*) even more reduced than in most *Lynchia;* cell between 5th longitudinal and axillary veins a combination of anal, 3rd posterior and axillary cells; a large postaxillary cell, sometimes with a longitudinal crease or rudimentary vein; membrane extensively covered with microtrichia on both upper and under surfaces, giving the wing a clouded or smoky appearance; alula very broad, not fringed; upper and lower calypteres present, but narrow. Halteres present, of normal shape. Abdomen with few differentiated sclerites; dorsally a large, transverse, basal sclerite (fused pleurotergites 1 and 2, as indicated by the position of spiracles 1 and 2), with the hind margin shallowly curved inward (in *O. sordida* triangularly excised in ♂, bilobed in ♀); as a rule, immediately behind this a single transverse, short median sclerite, sometimes partly divided medially, or with a pair of smaller, differentiated areas; a large, transverse preänal tergite, apical or ventral; sometimes traces of an additional lateral sclerite corresponding to spiracle 3; median dorsal area very finely, transversely striate (as in *Lynchia*), nearly bare; 7 pairs of abdominal spiracles, placed as in *Lynchia* (Fig. 89*C*); spiracle 2 usually free in ventral membrane, close to the ventral edge of basal pleurotergite, exceptionally (in *O. fossulata*) within pleurotergal sclerite. Rim of small, subcircular, saucer-shaped anal sclerite in ♀ usually with a pair of lobes projecting over the paragenital sclerite (Figs. 87*E* and 88*G*). Male terminalia as in *Lynchia,* without traces of gonocoxites; setigerous lobes (replacing the gonocoxites) developed into long, flap-like or finger-shaped, densely setulose processes. In a resting position the lobes cover the genital atrium, lying side by side, with the tips directed backward, and hiding the retracted 3 rods of the aedeagus (Fig. 88*F*). When the aedeagus is protruded for mating, the lobes are spread out to the right and left (Figs. 88*E* and 92). As the setigerous lobes are only slightly sclerotized, they shrivel in dry, pinned specimens and their shape cannot be trusted as characteristic for the several species. Setae of body rather sparse and short, particularly on thorax, which is mostly bare, except on humeral callosities, dorsal aspect of anepisterna, and small patches on sides of notum and near scutellum; scutellum without bristles, fringed beneath hind margin with short, soft hairs; preänal tergite with

a few long bristles; as a rule some longer bristles among the short setae on venter near anal and genital sclerites. Most species have a long or short row of stiff setulae on 1 or (rarely) 2 longitudinal veins. Head and thorax black, with few or no brownish or russet areas, often slightly metallic-greenish or bronzy; body never showing dull-green haemolymph through the integument.

Olfersia is in all essential characters one of the Ornithomyiinae, but with unusual specializations, such as the extension of the postvertex, the modified frons, the fusion of prescutum and notopleuron, the retort-shaped pleurotergal processes, and the hirsute puparium. These peculiarities have induced me to place it in a distinct tribe Olfersiini (Pt. II, p. 16).

Olfersia is chiefly tropicopolitan, extending only occasionally into subtropical areas. *O. fumipennis* is exceptional in that it spreads during the summer to the North temperate zone, as far north as its host, the osprey (*Pandion haliaetus*), breeds. The genus comprises 7 species, all found in the New World, 3 being endemic there.

Although *Olfersia* is a distinctive and compact genus of relatively few species, it uses for breeding purposes a variety of unrelated birds; but the hosts of each species belong to a definite taxonomic or ecological group. Thus *O. coriacea* is a specific parasite of game birds (Galliformes); *O. bisulcata* of Cathartidae (Falconiformes); *O. fumipennis* of Pandionidae (Falconiformes); *O. spinifera* of Fregatidae (Pelecaniformes); *O. aenescens* of Procellariiformes (Diomedeidae and Procellariidae), Pelecaniformes (Phaethontidae and Sulidae) and possibly Charadriiformes (Laridae); *O. sordida* of Pelecaniformes (Phalacrocoracidae and Pelecanidae); and *O. fossulata* of Pelecaniformes (Phalacrocoracidae, Sulidae and Pelecanidae). Occasional occurrences of these several species on other types of hosts appear to be due to accidental straying.

The puparium or full-grown larva are now known for 5 of the 7 species. In general shape these stages are similar to those of *Lynchia* and *Pseudolynchia*. They differ conspicuously, however, in being fairly uniformly covered with long, erect or slightly slanting, stiff hairs, a peculiarity not known elsewhere in Hippoboscidae. These hairs were first noticed on the puparium of *O. spinifera* by Courtiller (1853). The hairs are simply pointed in *O. bisulcata* (Fig. 93*F*); whereas their tips are anchor-shaped, provided with a pair of divergent minute barbs, in *O. spinifera*, *O. aenescens* (Fig. 88*I*), *O. fumipennis* and *O. coriacea*. The

hooklets are often missing, however, on most of the hairs, because the tips break off very easily. The meaning or use of the hirsute covering of the puparia is a moot point. A rather obvious surmise is to regard them as a means of adhering to the plumage of the host. This function is, however, most improbable in view of the fact that in all species for which observations are available, the gravid female leaves the host before voiding the full-grown larva, so that the puparia are normally found away from the birds. I suggest that after larviposition the puparia gather debris in the hairs so as to conceal them from potential parasites or predators. The hairs may also help the puparia to adhere more securely to the hiding places, particularly in the windswept rookeries of oceanic or shore birds, which are specific breeding hosts of some of the flies.

Considering the many specimens that I have examined, species of *Olfersia* appear to be on the whole less attacked by mites than most other genera of bird-flies. On the other hand, they are more often infested with the peculiar entomophagous fungi of the Order Laboulbeniales. In Part I (p. 141) I reported their occurrence on *O. bisulcata*, *O. aenescens* and *O. fumipennis*. I have since observed these fungi also on *O. sordida* and *O. coriacea*, so that they are known at present from 5 of the 7 species. According to Dr. R.K. Benjamin, who is studying this material, each of the 5 species of *Olfersia* seems to harbor its own specific *Trenomyces*. It should be noted that these fungi of hippoboscids are very minute, only a fraction of a mm. in length, so that they are easily overlooked. In addition they are dioecious, the male individuals being even smaller than the female. Both sexes may occur on the same individual fly, however. Material is most satisfactory for their study on flies originally collected and kept in alcohol.

Key to Species of *Olfersia*

The key includes only a selection of the characters which I have found most reliable for a preliminary identification. Additional distinguishing features are mentioned in the discussion of the affinities of the several species. Particular attention should be called to the shape and sculpture of the frons (fused lunula and interantennal area or frontal carina). This structure, highly distinctive for the genus, appears also to be most useful in determining the degree of intrageneric relationship of the species. A comparison of the drawings in Figs. 84, 85 and 86 will be more instructive in this connection than elaborate descriptions. *O. coriacea*

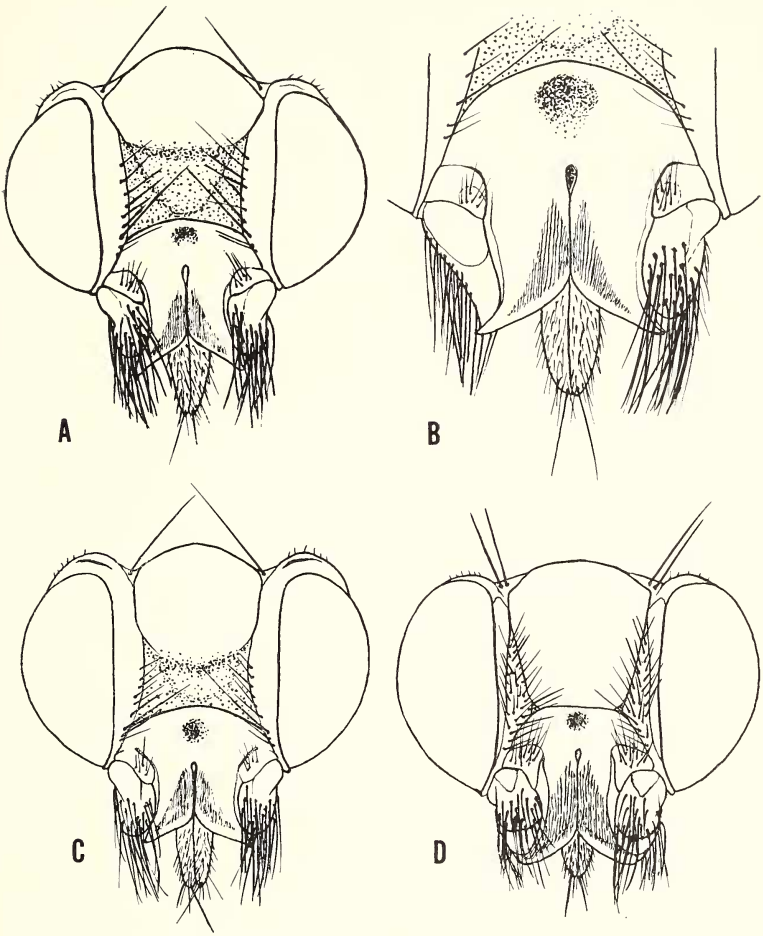

Fig. 85. **A**, head of *Olfersia spinifera* (Leach), ♂, Mayagüez, on *Fregata magnificens rothschildi;* **B**, frontal area and antenna of same, with 2nd antennal segment removed on one side to show the pit; **C**, head of *O. aenescens* C.G. Thomson, ♂, Ascension I.; **D**, head of *O. sordida* Bigot, ♀, Panama City, on *Pelecanus occidentalis californicus.*

(Fig. 84*B*) and *O. sordida* (Fig. 84*D*) are the most aberrant, each of them being also in other respects isolated within the genus. On the other hand, *O. spinifera* (Fig. 85*B*) and *O. aenescens* (Fig. 84*C*) show no appreciable differences possibly of diagnostic value, indicating how very closely related they are. *O. fumipennis* (Fig. 84*A*), *O. bisulcata* (Fig. 86*B*) and *O. fossulata* (Fig. 86*D*) also form a compact group of close relatives, as they share the nearly straight anterior margin of the frons, with only a small median notch; but there are some minor, though definite differences between them; it is, moreover, of interest that these 3 species have retained traces of the suture which originally divided the lunula from the frons proper, although the traces are very faint in *O. fossulata.*

1. Basal tergal sclerite of abdomen at apex with a median triangular notch in ♂, divided into 2 broad median lobes in ♀. First basal cell short and wide, distinctly bulging before apex; 3rd and 4th longitudinal veins with a row of setulae on both upper and under sides of wing; entire combined anal, 3rd posterior and axillary cells, as well as a narrow adjoining inner area of postaxillary cell, covered on upper surface of membrane with microtrichia, which extend over most of the postaxillary cell on the under surface. Postvertex forming an undivided, smooth sclerite from occiput to ptilinal suture. Wing 7 to 8 mm. long ..... *O. sordida*

   Apical margin of basal tergal sclerite of abdomen either nearly straight or broadly and evenly curved inward in both sexes. First basal cell long and narrow, nearly parallel-sided, not bulging apically; 4th longitudinal vein bare throughout; hind third to half of combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia on upper surface of membrane 2

2. Upper orbits prominent, nearly or fully as long as upper width of inner orbits; occipital margins of upper orbits and of postvertex strongly produced and separated on each side by a deep concave notch. Postvertex extending from occiput to ptilinal suture, but divided about mid-length by a slight transverse depression into an upper, smooth and a lower, duller area. Third longitudinal vein partly setulose (at least near the tip) on upper side of wing 3

   Upper orbits low, decidedly shorter than upper width of inner

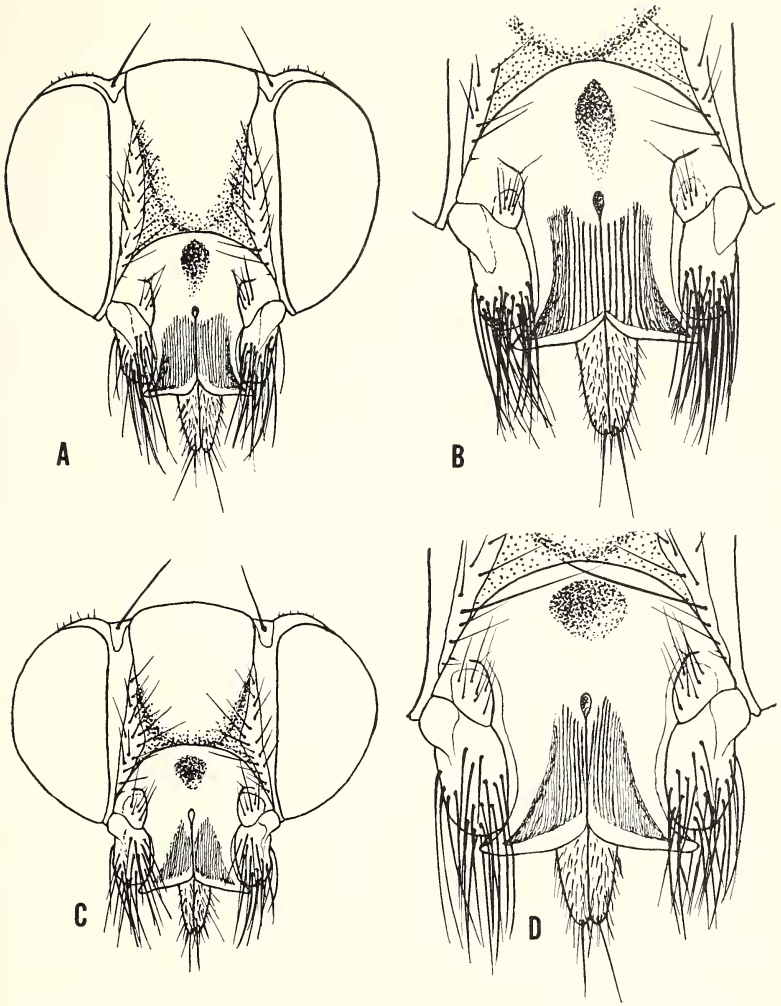

Fig. 86. **A**, head of *Olfersia bisulcata* Macquart, ♀, Turrialba, on *Cathartes a. aura;* **B**, frontal area and antennae of same; **C**, head of *O. fossulata* Macquart, ♀, Arica; **D**, frontal area and antennae of same.

orbits; occipital margins of upper orbits and of postvertex slightly or scarcely produced, separated on each side by very shallow inward curves 4

3. Occipital margin of postvertex somewhat more produced than that of the upper orbits. Anterior basal cross-vein (at tip of 2nd basal cell) very slanting, the upper apical angle of the cell acute; posterior area of combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia on both under and upper surfaces of membrane. Wing 7 to 9.5 mm. long. *O. spinifera*

Occipital margins of postvertex and of upper orbits about equally produced. Anterior basal cross-vein (at tip of 2nd basal cell) more nearly vertical, the upper apical angle of the cell almost square; entire combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia on upper surface only, the under surface of the membrane with microtrichia. Wing 6.5 to 8 mm. long ..... *O. aenescens*

4. Second basal cell short; second section of 4th longitudinal vein at least $1\frac{1}{2}$ times as long as first section of 5th; 3rd longitudinal vein partly setulose on upper side of wing (at least near the tip). Postvertex an almost continuous smooth sclerite from occiput to ptilinal suture, only the sides of the lower portion somewhat duller. Wing 7 to 8.5 mm. long ..... *O. bisulcata*

Second basal cell long; second section of 4th longitudinal vein at most $1\frac{1}{3}$ times as long as first section of 5th (sometimes about the same length) 5

5. Third longitudinal vein setulose throughout on upper side of wing (also basally). Interocular face at its narrowest about $1\frac{1}{2}$ times as wide as an eye; postvertex a continuous, nearly uniformly smooth sclerite from occiput to ptilinal suture. Wing 7 to 9 mm. long ..... *O. fumipennis*

Third longitudinal vein bare or at most with a few minute setulae on apical section only 6

6. Interocular face $1\frac{2}{3}$ times as wide as an eye; postvertex an undivided, nearly uniformly smooth sclerite from occiput to ptilinal suture. Wing 7.5 to 9 mm. long. *O. fossulata*

Interocular face about $1\frac{1}{4}$ times as wide as an eye, rarely somewhat more. Postvertex extending from occiput to ptilinal

suture, but divided by a slight transverse depression into an upper, smooth and a lower, duller area. Wing 6 to 7.5 mm. long ..... *O. coriacea*

Olfersia spinifera (Leach)

Figs. 85*A–B* and 87*A–I*

[*Hippobosca nigra* Osbeck, 1757, Dagbok öfver en Ostindisk Resa (1750–1752), p. 297 (Ascension I.: on "*Pelecanus aquilus*" = *Fregata aquila*). Pre-Linnean and without description].

[*Ornithomyia pelecani liscatoris* v. Olfers, 1816, De Vegetativis Animatis in Corporibus Animatis Reperiundis, **1**, p. 103 (Ascension I.); with "*Hippobosca nigra* Osbeck" as synonym; without description. *Nomen nudum*].

Feronia spinifera Leach, 1817 (September), Gen. Spec. Eproboscideous Ins., pp. 6 and 11; Pl. 26, figs. 1–3 [1818, Mem. Werner. Nat. Hist. Soc., Edinburgh, **2**, pt. 2, pp. 552 and 557; Pl. 26, figs. 1–3] (no sex; no host; no locality. Type probably lost, not now at Brit. Mus.); 1817 (November), Brewster's Edinburgh Encyclopaedia, **12**, pt. 1, p. 162 (no specific description, but with a brief generic diagnosis).

Olfersia spinifera Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 607 (with new description. Doubtfully from Cape of Good Hope). Speiser, 1899, Wien. Entom. Zeitg., **18**, p. 202. Aldrich, Insecutor Inscitiae Menstruus, **11**, p. 77 and 78. Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (Galapagos: Tower I., on *Fregata* "*aquila*" [= *F. m. magnificens*]). Curran, 1932, Nyt Mag. Naturvidenskab., **71**, p. 366 (Galapagos: Floreana [or Charles] I., on *Fregata* sp.). J. Bequaert, 1933, Psyche, **40**, pp. 102 and 103; 1933, Proc. California Ac. Sci., (4), **21**, No. 11, p. 132. Thompson, 1938, Ent. Mo. Mag., **74**, p. 44. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 319 and 320; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **16**, No. 11, pp. 271 and 273, figs. 3*a-b*. Wolcott, 1941, Jl. Agric. Univ. Puerto Rico, **25**, pt. 2, p. 121 (Puerto Rico: Mona I. and Mayagüez, on *Fregata magnificens rothschildi*). Guimarães, 1945, Arq. Museu Paranaense, **4**, pt. 7, p. 180 (Brazil: Guaraqueçaba, State Paraná, on *Fregata magnificens rothschildi*). Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 155 (St. Croix: on *Fregata magnificens rothschildi*). Ramos, 1947, *Op. cit.*, **30**, (for 1946), pt. 1, p. 62 (Puerto Rico: Mona I., on *Fregata magnificens rothschildi*). Wolcott, 1951, *Op. cit.*, **32**, (for 1948), pt. 3, p. 530.

Feronia (*Olfersia*) *spinifera* Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 229 (synonymizes *Olfersia courtilleri* Courtiller).

Pseudolfersia (*Feronia*) *spinifera* Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 265 (synonymy of *O. unicolor* Walker; in part: only specimen from Ascension I.; not the specimen from Pará, on *Catharistes urubu*, which was *O. bisulcata*).

Pseudolfersia spinifera Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, pp. 146–149 and 179 (synonymizes *O. courtilleri* "Fairmaire" and probably also *O. unicolor* Walker; claims that Leach's type came from Java, but does not say why). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, pp. 244, 246, 303 and 304; 1909, Deutsche Südpolar-Expedition, **10**, (Zool., 2), pt. 4, p. 531 (Ascension I.: on *Fregata aquila*); 1909, Jl. f. Ornithologie, **57**, p. 101. Schaeffer, 1914, Brook-

lyn Inst. Mus., Sci. Bull., **2**, pt. 4, p. 93 (near the rocks of Trinidad Islet, South Atlantic Ocean). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 179 and 188; Pl. 27, fig. 2 (Brazil: Rio de Janeiro, on *Fregata aquila*). Brèthes, 1918, Rev. Chilena Hist. Nat., **22**, p. 122 (Peru: Lima; a doubtful record). Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 196 (in part: Mexico: Cape San-Lucas, Baja California, ♂ on *Fregata aquila;* not the figures, which are *O. aenescens*). Luederwaldt and Pinto da Fonseca, 1922, Rev. Mus. Paulista, **13**, pp. 480 and 497 (Ilha dos Alcatrazes, off the coast of Brazil: common in nests of *Fregata minor*). Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull. **4**, pts. 1–2, p. 90.

Olfersia sp. Howard, 1890, Proc. U.S. Nat. Mus., **12**, No. 771, (for 1889), p. 206 (3 miles from Abrolhos Is., off Brazil, flying on board ship; specimen seen by me at U.S. Nat. Mus.).

Ornithomyia unicolor Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1144 (no sex. Jamaica, on *Fregata aquila*. ♂ ♀ at Brit. Mus., the ♂ now labelled as type from *Fregata aquila*). Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 213. Johnson, 1894, Proc. Ac. Nat. Sci. Philadelphia, p. 281. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 190 (copy of description).

Olfersia courtilleri "Fairmaire" Courtiller, 1853, Ann. Soc. Linn. Dépt. Maine-et-Loire, Angers, **1**, p. 196; Pl. 15 (no sex. France: Saumur, on *Fregata* ["*Tachypetes*"] *minor*. Puparium. [Both Bigot, 1885, and Speiser, 1902, saw the type and recognized in it *O. spinifera*. Bigot misspelled the name "*courtilieri*"]. Type ♂ from Bigot Coll. now in J. E. Collin Coll.).

Olfersia curtilleri Rondani, 1879, Bull. Soc. Ent. Italiana, **11**, p. 23 (misspelling of *courtilleri*).

Olfersia sulcifrons C. G. Thomson, 1868, Eugenies Resa, **2**, Zool., pt. 1, Insekter, p. 611 (no sex; no host. Panama: Type in Stockholm Mus.). Osten Sacken, 1878, Smithson. Misc. Coll., No. **270**, p. 149.

Pseudolfersia sulcifrons Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 149. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656.

Pseudolfersia spinifera var. *sulcifrons* Speiser, 1904, Zeitschr. Syst. Hym. Dipt., **4**, p. 83 (type); 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Ornithomyia sp. Dahl, 1892, Ergebn. Plankton-Exped., **1**, pt. A, p. 206 (Ascension I.: on *Fregata aquila*).

Distribution and Specimens Examined. United States. Florida: Sebastian, Indian River Co., on *Pelecanus o. occidentalis* (A. Wetmore). — Louisiana: Quarantine, Plaquemines Parish, on *Fregata magnificens rothschildi* (C.L. Sperry).

Mexico (recorded by Ferris and Cole, 1922).

British Honduras: Turneffe Is., on *Fregata magnificens rothschildi* (S.M. Russell).

Panama (recorded by Thomson, 1868): Taboguilla I., C.Z. (T. Hallinan).

Antilles. Bahamas: Great Salt Cay, on *Phalacrocorax auritus floridanus* (Am. Mus. Nat. Hist.); Six Hills Cay, Caicos Is., on *Fregata magnificens rothschildi* (H.S. Peters). — Cuba: Matanzas, Prov. Matanzas, on *Fregata magnificens rothschildi*

(C. Sanchez). — Isle of Pines: Bird I., on *Fregata magnificens rothschildi* (G. Link). — Cayman Islands: Little Cayman, on *Fregata magnificens rothschildi* (H.S. Peters). — Jamaica: (recorded by Walker, 1849, as *unicolor*): ♀ ♂, the ♂ type of *unicolor*, on *Fregata aquila* (P.H. Gosse. — Brit.Mus.); North East Cay and Middle Cay, Pedro Cays, on *Fregata magnificens rothschildi* (C.B. Lewis); South West Cay, Drunkenman's Cay and Port Royal Cay, Pedro Cays, on *Fregata magnificens rothschildi* (R.P. Bengry). — Puerto Rico (recorded by Wolcott, 1941, 1951; Ramos, 1947): Mayagüez, on *Fregata magnificens rothschildi* (J.A. Ramos) and on *Pelecanus o. occidentalis;* Mona I., on *Fregata magnificens rothschildi.* — St. Croix (recorded by Beatty, 1947): on *Fregata magnificens rothschildi* (H.A. Beatty).

Brazil (recorded by Howard, 1890; Schaeffer, 1914; Lutz, Neiva and da Costa Lima, 1915; Luederwaldt and Pinto da Fonseca, 1922; Guimarães, 1945): Rio de Janeiro, on *Fregata aquila* (Ad. Lutz. — Specimen recorded in 1915, now at U.S.Nat. Mus.); Trinidad Islet, off Brazil, 20° 30′ S., 29° 20′ W. (R.C. Murphy; also received from P. Wygodzinsky); 3 miles off Abrolhos Is., coast of Bahia, 18° S. (Albatross Exped. — Recorded by Howard, 1890); Ilha da Queimada Grande, State São Paulo, on *Fregata magnificens rothschildi* (E. Dente); Ilha dos Alcatrazes, State São Paulo, on *Fregata magnificens rothschildi.*

Ascension I. (recorded by Osbeck, 1757; Dahl, 1892; Speiser, 1909): (H. Giammarco).

?Peru (recorded by Brèthes, 1918, but identification doubtful).

Galapagos (recorded by Johnson, 1924; Curran, 1932): Darwin Bay, Tower I. (M. Willows, Jr.; W.H. Osgood and D. Lambert); Tower I., on *Fregata minor ridgwayi* (J.P. Chapin) and on *Fregata m. magnificens* (W. Beebe; W.S. Brooks); Post Office Bay, Charles I. [or Floreana] (A. Wollebaek); Conway Bay, Indefatigable I., on *Fregata m. magnificens* (J.P. Chapin); Kicker Rock, on *Fregata* sp. (H.A. Pilsbry); Wenman I.

Like its breeding hosts, the frigate birds, *O. spinifera* is nearly cosmopolitan over the tropical seas. In the Old World I have seen it from Christmas I. (Indian Ocean, 10° 23′ S., 105° 43′ E.), Aldabra I. (specimens recorded by Scott, 1914, p. 162, seen at Cambridge Univ. in 1951), the Philippines (Cavilli I., on *Fregata aquila.* — Stanford Univ.), the coast of New South Wales, the Solomons, Tuamotus, Gilberts, Marquesas, Fijis, and Hawaiian Islands. The few records outside the intertropical zone are clearly

stray occurrences. The northmost localities in the New World are in Louisiana (Quarantine, 29° 15′ N.) and Florida (Sebastian, 27° 45′ N.). There are also two European records, from Saumur, Central France (Courtiller, 1853), and from Tiree I., Inner Hebrides, Scotland (Stephen, 1953), both from stray *Fregata magnificens rothschildi*. In the Southern Hemisphere, it extends to just south of the Tropic of Capricorn on the coast of Brazil and of New South Wales.

Known American Hosts of *O. spinifera* (verified individual records in parentheses). Pelecaniformes (21): *Fregata aquila* (2); *F. m. magnificens* (2); *F. magnificens rothschildi* (13); *F. minor ridgwayi* (1); *Pelecanus o. occidentalis* (2); *Phalacrocorax auritus floridanus* (1).

Most of the reliable records in the Old World are from *Fregata aquila* and *F. minor*. The recorded occurrences on pigeons (Janson in Ormerod, 1889, p. 61; Froggatt, 1900, p. 1091; Gedoelst, 1911, p. 245), noddies (Schiner, 1868, p. 373), boobies (Ricardo, in Forbes, 1903, Natural History of Sokotra, p. 376; Austen, 1903, p. 265), albatrosses (Ferris and Cole, 1922, p. 196), shearwaters (Ferris, 1927*c*, p. 220), tropic-birds (Falcoz, 1930, p. 45), and diurnal birds of prey (Austen, 1903, p. 265; Ferris and Cole, 1922, p. 196; Dunn, 1934, p. 175) were all based on misidentifications, usually of *Olfersia aenescens* Thomson, *O. sordida* Bigot, or *O. bisulcata* Macquart.

Bionomics. I regard the true *O. spinifera* as a strictly specific parasite of the circumtropical frigate or man-of-war birds (*Fregata*), which are its only regular breeding hosts. The very few specimens actually found on pelicans and cormorants were no doubt strays, acquired temporarily when these birds were nesting or roosting in rookeries close to frigate birds. F.W. Jones (1909, pp. 150–151) noted that, on Cocos Keeling Atoll (Indian Ocean), the flies swarmed over the *Fregata* nestlings and were seen crawling over the bushes nearby.

The puparium of *O. spinifera* was figured by Courtiller, who described it as follows (1853, as *O. courtilleri*): "Puparium large, oval, very short, thick, hirsute with small stiff hairs, except on the operculum [actually the posterior spiracular area] which bears two somewhat rugose protuberances [the polypneustic lobes]. When voided the puparium was a beautiful white except for the two protuberances, which were black; gradually the white color turned brownish and within 5 or 6 hours the entire puparium became brown." Dr. C.B. Lewis (*in litt.*, 1950) found *O. spinifera*

extremely numerous around nests of frigate birds on the Middle Cay of the Pedro Group near Jamaica. In a nest he collected and brought back to the Jamaica Science Museum, and which was searched for parasites by Mr. R.P. Bengry, puparia of *Olfersia* were found underneath the platform of lime and attached to the twigs. In June, 1952, Mr. K.L. Maehler obtained on Johnston I., Hawaiian Is., from flies associated with frigate birds, 3 puparia used for the following description. The puparium (Fig. 87*I*) is broadly oval, almost elliptical seen from above, about 4 mm. long, 2.8 mm. wide and 2.5 mm. thick. It is mostly covered with numerous, irregularly spaced stiff hairs, each ending at the very slender tip in a pair of minute, divergent barbs, similar to those of *O. aenescens* (Fig. 88*J*). The surface in addition is densely pitted. Both the hairs and pits are lacking over an anterior circular ring which delimits the future cap pushed off by the emerging adult. The two respiratory polypneustic lobes of the respiratory cap at the posterior end are separated by a notch deeper and narrower than in *O. aenescens;* their surface is bare, but densely and minutely punctate. Each polypneustic lobe bears 40 to 45 respiratory pores, each on a low and fairly large mound.

To the two cases of infestation with mites mentioned in Pt. I (p. 159) the following may be added.

3. Two ♂ from Nengo Nengo I., Tuamotu Group (Pacific Ocean), on *Fregata* sp., each carried a ♀ mite surrounded by eggs: in one fly on the side of the left basal laterotergite of the abdomen; in the other, on the right side of the thorax, in the deeply grooved anepisternum, below the prothoracic spiracle.

4. One ♂ from St. Croix I., on *Fregata magnificens rothschildi*, carried a ♀ mite, without eggs, on the outer side of the mid left tibia.

5. One ♂ from Mayagüez, on *Fregata magnificens rothschildi,* carried a ♀ mite with egg cluster on the upper side of the left mid femur, at about mid-length.

6. One ♂ from Canton I., Gilbert Group (Pacific Ocean), carried an egg cluster and ♀ mite on the left dorsal side near the tip of the abdomen.

In Part I, I mentioned what is known of the larviposition (p. 194) and host relations (pp. 250 and 316) of *O. spinifera.*

Affinities. The following additional characters of *O. spinifera* may be noted. Interocular face from $1\frac{1}{2}$ to $1\frac{2}{3}$ times the width of an eye in ♀, nearly twice that width in ♂ (Fig. 85*A*). First antennal segment completely separated from the fused frons and

lunula in some specimens, incompletely in others. Palpi relatively long, extending much beyond apical edges of frons. Transverse, shallow depression of postvertex nearly straight, placed close to mid-length. One vertical bristle on each side of postvertex. Interantennal part of frons (Fig. 85*B*) very finely rugulose over a narrow triangular area of inner half only; free, divergent apices separated by a deep triangular notch, the narrowed, outwardly directed points rather sharp, the surface very shallowly grooved throughout. Mesonotum on each side with 3 small patches of dull pruinosity, behind posthumeral suture, along transverse mesonotal suture and near scutellum; anterior margin with three broad, arched notches, to receive the produced postvertex and upper orbits. First longitudinal vein ending about opposite anterior cross-vein; 2nd longitudinal ending nearly twice as far from tip of 1st as from tip of 3rd. Longitudinal suture extending over nearly entire sternum; metasternum and mesofurcasternum completely divided by a distinct suture. Abdomen of ♀ (Fig. 87*C*) with large basal sclerite of normal shape, the hind margin broadly curved inward medially, where it is followed by a short, transverse, ribbon-like plate in which a pair of rugulose plates are more or less set off in the middle; preäpical dorsal sclerite transverse, rather short, with an irregular row or group of 7 or 8 long bristles on each side near hind margin; lobes on rim of anal sclerite (before genital sclerite; Figs. 87*E–F*) prominent, triangular and bluntly pointed in flies preserved in alcohol (much narrower and bluntly finger-shaped in dry specimens; Fig. 87*F*). Abdomen of ♂ (Fig. 87*D*) with ribbon-like anterior dorsal sclerite (behind the fused laterotergites) much smaller than in ♀, and with the preäpical dorsal sclerite larger; the setigerous lobes at sides of aedeagus appear somewhat narrower and more finger-shaped than in *O. aenescens* (particularly when spread out in dry, pinned flies). The species averages slightly larger than *O. aenescens*, the wing being 7 to 9.5 mm. long; but some flies of both species are the same size.

The earliest reference to the fly of frigate birds was by Osbeck (1757). He mentioned an insect occurring on "*Pelecanus aquilus*" at Ascension I., which he called "*Hippobosca nigra*". The name is pre-Linnaean and, moreover, was published without a description. v. Olfers (1816) listed Osbeck's name in the synonymy of his "*Ornithomyia pelecani liscatoris,*" but he neither saw a specimen, nor gave a description; so that his names are also *nomina nuda.*

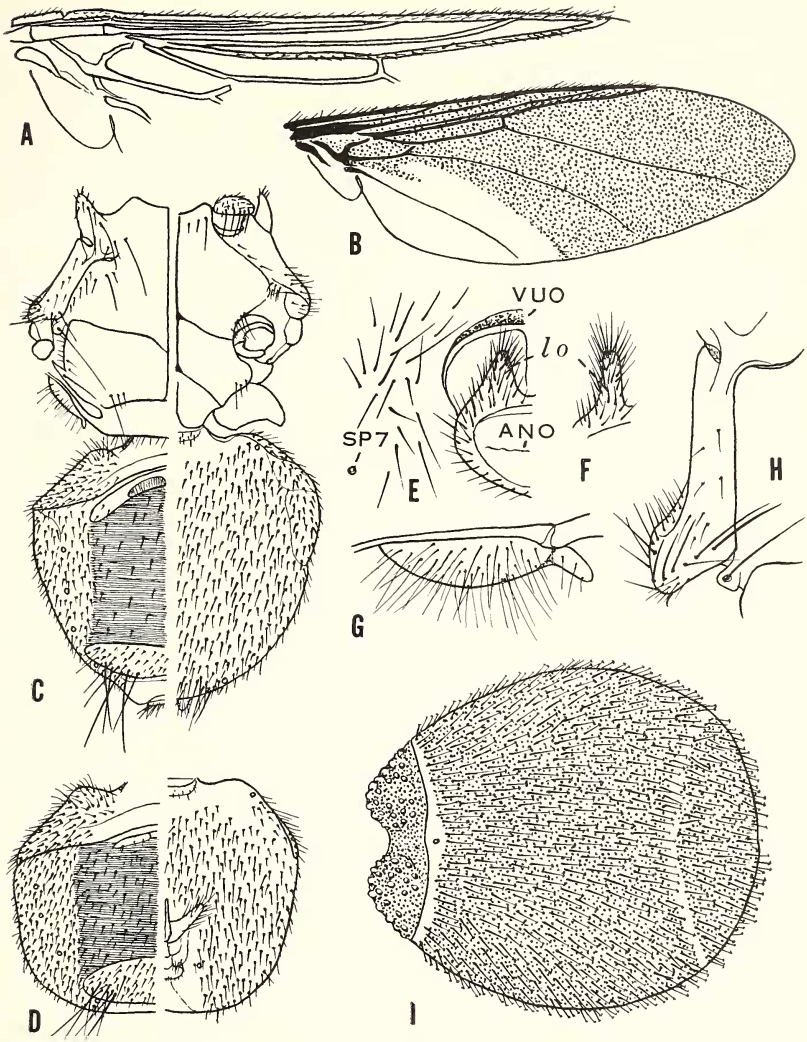

Fig. 87. *Olfersia spinifera* (Leach). **A**, anterior area of wing, the microtrichia omitted, ♀, Taboguilla I.; **B**, wing of same; **C**, thorax and abdomen dorsally and ventrally, ♀, Conway Bay, Indefatigable I., on *Fregata m. magnificens;* **D**, abdomen dorsally and ventrally, ♂, Tower I., on *Fregata minor ridgwayi;* **E**, one side of ventral ano-genital area, ♀, Conway Bay, drawn from fly in alcohol: *ANO*, anal opening; *lo*, lobe on rim of anal sclerite; *SP?*, 7th abdominal spiracle; *VUO*, vulvar opening; **F**, lobe on rim of anal sclerite, ♀, Lau, Fiji Is., drawn from dry fly; **G**, left metanotal pleurotergite, ♂, Canton I., Pacific Ocean; **H**, dorsal aspect of left anepisternum, ♀, Taboguilla I.; **I**, puparium from fly on *Fregata* sp., Johnston I., Pacific Ocean.

Original description of *F. spinifera:* "F. piceo-atra, alis obscuris; angulo anali subhyalino nitente, thorace angulis antice utrinque spina acuta armato. Caput nigrum: oculi rufi; labium albidum: vagina picea. Thorax piceo-ater, antice spina acuta utrinque armatus: pectus piceum: alae obscurae angulo anali subhyalino nitente: pterigostea picea; limbalibus basi pallidis: pedes supra picei, subtus testaceo-picei; ungues atra." The type, described from MacLeay's collection, has not been seen by any later author and presumably is lost. The description mentions no character now regarded as specific in *Olfersia* and could apply as well to *O. aenescens* as to the species from *Fregata* usually called *spinifera.* Leach's original figures agree in some respects better with *O. aenescens:* the occipital margins of postvertex and upper orbits are drawn about equally produced behind, while the cross-vein closing the second basal cell is shown vertical. It is doubtful, however, whether the drawings can be fully trusted for such details. Speiser (1902) gave the first recognizable description of *spinifera,* based on a fly from a frigate bird of Laysan I. and I have followed his interpretation of the name. If the name *spinifera* were eventually rejected for the frigate bird parasite, *unicolor* Walker should be used instead for it.

Original description of *O. unicolor:* "Nigro-picea, pedibus piceis, alis fuscis. Body, including the mouth and appendages, pitchy-black: head and chest shining: head smooth: eyes pitchy; the facets rather large: chest finely punctured: abdomen dull: legs pitchy, clothed with short black hairs and bristles; claws black: wings brown; wing-ribs and fore border veins pitchy; the other veins dark tawny: Length of the body 3½ lines [= 7.4 mm.]; of the wings 9 lines [= 19 mm., the wing span]." The type series consisted originally of three specimens, now at the British Museum, where I recognized them as *O. spinifera* in 1951, as Austen (1903) had done before. More recently, Dr. F.I. van Emden confirmed at my request that the specimen now marked as the "type" is a male labelled "Jamaica, Gosse, from *Fregata aquila,* 47.62;" its wing, measured by Dr. G.B. Fairchild, is 9.5 mm. long. Another specimen is a female, labelled as the first (47.62), with a wing length of 9.6 mm. The third fly, also a female, labelled only "Jamaica, Gosse, 46.84," has the wing 10.1 mm. long; whether or not this is the fly mentioned by Walker as taken on "*Ephialtes grammicus*" remains uncertain; but the indication of this owl as the host was certainly erroneous.

Original description of *O. sulcifrons:* "Nigro-aenea, subtus cum pedibus sordide testacea, thorace margine antico 3-sinuato, callo humerali pallido, spinoso-producto; alis griseo-hyalinis, nervis nigro-piceis, transverso-ordinario fere ante postcostae exitum sito. Long. 8 (cum alis 13) mil. Praecedenti [*O. aenescens* Thomson] simillima, frontis sulco transverso aeque ab epistomate ac a margine postico remoto, alis obscurioribus, costae abscissa 2:a 3:a multo longiore, nervo transverso-ordinario fere ante postcostae exitum sito, cellula humerali nervo obliquo occlusa, tarsis articulo 5:o magis dilatato satis superque distincta." This description mentions several of the distinctive, specific features and the type, which I examined in 1932, agrees in every respect with what is here called *O. spinifera.*

Original description of *O. courtilleri* (translated from the French): "Length, from head to tip of wings, 14 mm. Very dark brown, shiny and somewhat bronzy above; head very smooth and shiny; a transverse depression between the eyes and beneath it a small pit in which ends the groove dividing the epistome [frons]; antennae and beak hairy. Thorax on each side of the anterior margin with a strong russet tooth. On the sides, below, a depression to receive the femora at rest; also the fore coxae are silky and serve as cushions to receive the head when this is pressed against the body; side corners of the thorax prominent, but rounded off and with a tuft of setae; wings large, smoky, with dark veins. Legs robust, the hind legs very long, blackish brown, dirty russet beneath." The accompanying figure is rather poor and not reliable for the details of the head and wing venation. The type was acquired by

Bigot and is now in the J. E. Collin collection. Both Bigot (1885) and Speiser (1902), who also saw it, recognized that it was the cosmopolitan parasite of frigate birds. Mr. Collin compared it at my request with Bigot's type of *O. erythropsis*, and sent me some notes reproduced in the discussion of *O. aenescens*. I was recently (1951) able to study it myself and to establish that it is a male.

Olfersia aenescens C.G. Thomson

Figs. 21, 84*C*, 85*C*, and 88*A–J*

Olfersia aenescens C.G. Thomson, 1868, Freg. Eugenies Resa, **2**, Zool., pt. 1, Ins., Häft 12, Dipt., p. 610 (no sex; no host. Keeling I., Indian Ocean. Type at Stockholm Mus.). J. Bequaert, 1933, Psyche, **40**, p. 105. Thompson, 1938, Ent. Mo. Mag., **74**, p. 43. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, pt. 4, p. 320; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **14**, No. 11, pp. 271 and 277, figs. 4*a–b*. Wolcott, 1941, Jl. Agric. Univ. Puerto Rico, **25**, pt. 2, p. 121. Beatty, 1947, *Op. cit.*, **28**, (for 1944), pts. 3–4, p. 154 (St. Croix I., on *Sula l. leucogaster*). Wolcott, 1951, *Op. cit.*, **32**, (for 1948), pt. 3, p. 530. J. Bequaert, 1951, Bull. Brooklyn Ent. Soc., **46**, p. 49.

Pseudolfersia aenescens Speiser, 1904, Zeitschr. Syst. Hym. Dipt., **4**, p. 83 (type); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 302.

Olfersia erythropsis Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 239 (no sex; no host. New Caledonia. Type ♂ from Bigot Coll., now in J.E. Collin Coll.). J. Bequaert, 1933, Psyche, **40**, pp. 102 and 103; 1933, Proc. California Ac. Sci., (4), **21**, pp. 132 and 133. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 155 (St. Croix I., on *Sula d. dactylatra*).

Pseudolfersia erythropsis Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 165 (type).

Pseudolfersia diomedeae Coquillett, 1901, Proc. Washington (D.C.) Ac. Sci., **3**, p. 379 (no sex. Galapagos: Albermarle I., on *Diomedea irrorata*. Holotype ♂, No. 4431, and 2 ♂ paratypes now at U.S. Nat. Mus.; 1 ♂ paratype at Stanford Univ.). Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Olfersia diomedeae Curran, 1932, Nyt Mag. Naturvidenskab., **71**, p. 366. Wolcott, 1936, Jl. Agric. Univ. Puerto Rico, **20**, pt. 1, p. 392 (Puerto Rico: Desecheo I., on *Sula l. leucogaster*).

Pseudolfersia spinifera Johnson, 1908, Psyche, **15**, p. 80 (in part: only specimens from Bahamas, on *Sula l. leucogaster*). Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 196 (in part: only paratype ♂ of *diomedeae* from Albemarle I.), figs. 13 and 14*A–C* (drawn from ♂ paratype of *diomedeae*). Not of Leach, 1817.

Olfersia fossulata Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (in part: only specimens from Bahamas, on *Sula l. leucogaster*). Not of Macquart, 1843.

Distribution and Specimens Examined. Mexico: Isabel I., off Pacific Coast, State Nayarit, on *Sula nebouxi* (J. Garth); Clarion I., Revilla Gigedo Group (Pacific Ocean), on 2 *Sula dactylatra californica* (J. Kieffer; W.A. McDonald and Blodget).

Panama: without more precise locality, on *Sterna fuscata crissalis*, June 16 (W. Beebe).

Cocos I.: on *Sula leucogaster brewsteri* (W. Beebe).

Antilles. Bahamas (recorded by Johnson, 1908, 1924): Mangrove Cay, Andros I., on *Sula l. leucogaster* (specimen referred by Johnson to *spinifera* in 1908 and to *fossulata* in 1924). — Puerto Rico (recorded by Wolcott, 1936, 1951): Desecheo I., on *Sula l. leucogaster* (S.T. Danforth); Mona I., on *Sula l. leucogaster, Sterna anaethetus melanoptera,* and *Anoüs s. stolidus* (W. Pippin). — St. Croix (recorded by Beatty, 1947): on *Sula l. leucogaster* and *Sula d. dactylatra* (H.A. Beatty).

Brazil: Fernando de Noronha I. (MacCreary); Trinidad Islet, 20° S. (R.C. Murphy).

Galapagos (recorded by Coquillett, 1901, as *diomedeae*): Albemarle I., on *Diomedea irrorata* (types of *diomedeae*); Indefatigable I. (M. Willows, Jr.); Hood I., on *Diomedea irrorata* (F.X. Williams); Tower I., on *Sula sula rubripes* (W. Beebe).

Ascension I.: common (D.E. Hardy; W. Ford; J.R. Fisher).

O. aenescens is probably tropicopolitan in the Atlantic, Indian and Pacific Oceans. There are many records from the Pacific area (J. Bequaert, 1941*b*). I have also seen it from Establishment I., Cargados Carajos Group, 16° 30′ S., 59° 40′ E. (specimens listed as *O. spinifera* by H. Scott, 1914, p. 162); Socotra (Simony); St. Paul's Rocks, 38° 40′ S., 77° 34′ E.; northeast coast of Australia (on *Sula australis*); and Boa-Vista I., Cape Verde Is. (L. Fea). It is a truly oceanic insect, which never strays far inland. The northmost record is Isabel I., off the west coast of Mexico (22° N.); the southmost, St. Paul's Rocks in the Indian Ocean (38° 40′ S.).

Known American Hosts of *O. aenescens* (verified individual records in parentheses). Procellariiformes (2): *Diomedea irrorata* (2). Pelecaniformes (12): *Sula d. dactylatra* (3); *S. dactylatra californica* (2); *S. l. leucogaster* (4); *S. leucogaster brewsteri* (1); *S. nebouxi* (1); *S. sula rubripes* (1). Charadriiformes (3): *Anoüs s. stolidus* (1); *Sterna anaethetus melanoptera* (1); *S. fuscata crissalis* (1).

Bionomics. *O. aenescens,* a specific parasite of oceanic fish-eating birds, has been taken on a variety of hosts. The evidence is as yet insufficient to decide whether or not any of these are preferred as true breeding hosts. In America it occurs most often on boobies (*Sula*) and more rarely on albatross (*Diomedea*), noddy terns (*Anoüs*), and sooty terns (*Sterna*). Elsewhere, particularly in the Pacific area, it is common on tropic-birds (*Phaëthon*), but is found also on petrels (*Pterodroma*), shearwaters (*Puffinus*), and noddies (*Anoüs*). All these sea birds are so-called "swimmers", with similar habits of feeding at sea and nesting or roosting in

populous colonies on oceanic islands. In this case the number of verified host records listed above gives no idea of the frequency and density of the infestations. In the rookeries nearly all young and adult birds carry some flies, as shown in Fig. 21 (Pt. I, p. 251).

O. aenescens has not been taken thus far on a live host in the continental waters of the United States. However, on two occasions a dead male was found by the U.S. Public Health Service, after fumigation, inside aircraft arriving from overseas at Miami Beach, Florida; both planes had last touched land in Puerto Rico, one having started from Accra, Gold Coast, and the other from Trinidad. A dead fly was also found at San Francisco on a plane arriving from across the Pacific (Sept. 7, 1937). Other specimens were taken by F.C. Hadden at Midway Island, in the Pacific, on 4 commercial planes eastbound from Hawaii. I have also seen a ♂ taken at Guam on a plane eastbound to the Philippines (Dec. 17, 1938). The frequent occurrence of *O. aenescens* on aircraft may be explained by the roosting and nesting habits of the hosts. Dr. J.P. Chapin pointed out that sooty terns in particular nest in colonies precisely on the flat, open areas suitable for airstrips at mid-ocean stopping places. During the second world war, at Ascension I., in the southern Atlantic, sooty terns habitually came in at dusk to roost near the end of runways on the airfield, where eventually they would start nesting. The birds were a serious hazard there because of their habit of flying in a cloud ahead of departing planes (J.P. Chapin, 1946, Natural History, New York, **55**, pp. 313–319). Sooty terns presented the same problem on the airfield at Johnston I. and probably elsewhere in the Pacific. The close proximity of airfields to colonies of sooty terns or other suitable bird hosts accounts for *O. aenescens* entering planes landing at such places, where the planes remain open for some time. It is, moreover, possible that when a closed plane hits a flock of birds after taking off, killing some of them in the process, a fly might alight on the outside of the moving aircraft and eventually find its way inside. The flattened body and the habit of sliding beneath feathers allow a hippoboscid to enter even very narrow openings (J. Bequaert, 1951*b*).

When *O. aenescens* is abundant in rookeries, feeding mainly on young birds, some of the flies are often observed running over rocks or low vegetation. These flies may be newly emerged adults or gravid females in search of appropriate shelter for larviposition. They are then more exposed to predators than when they are hidden within the bird's plumage. Dr. W.W. Wirth observed spiders

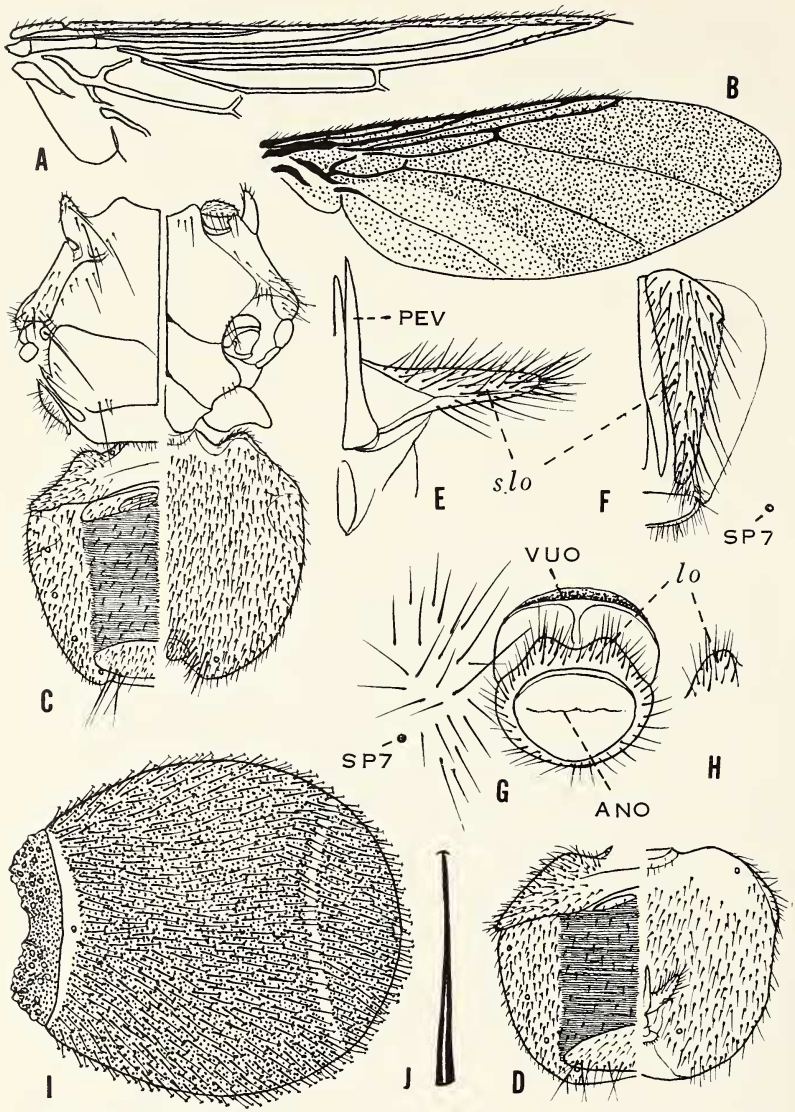

Fig. 88. *Olfersia aenescens* C.G. Thomson. **A**, anterior part of wing, the microtrichia omitted, ♀, Desecheo I., on *Sula l. leucogaster;* **B**, wing of same; **C**, thorax and abdomen dorsally and ventrally of same; **D**, abdomen dorsally and ventrally, ♂, Ponape I., Pacific Ocean, on *Anoüs minutus marcusi;* **E**, one half of ♂ terminalia ventrally in extended condition, Ascension I.: *PEV*, penis valve; *slo*, setigerous lobe at side of genital atrium; **F**, one half of ♂ terminalia ventrally in folded condition, Ponape I., on same host: *slo*, setigerous lobe at side of genital atrium; *SP7*, 7th abdominal spiracle; **G**,

capturing such flies in the open on Rabbit I., off Oahu (*in litt.*, November 7, 1946; see Part I, p. 131).

The flies alluded to in the following passage of R.C. Murphy's "Oceanic Birds of South America" (1936, vol. 2, p. 850), were presumably *O. aenescens*, although no specimens were available for naming. "All of the nesting white boobies [*Sula dactylatra*] at La Plata [off the coast of Ecuador] had curious blackish blue, cloudy spots on the outer white feathers of their throats, just below the pouch. Sometimes there were half a dozen of these, and while I was examining them on living birds I found, to my astonishment, that the spots changed their position and shape. Closer inspection showed that the marks were made by hippoboscid flies, buried just under the surface of the snowy feathers so that they were only half veiled. They were present at all times among the feathers of every one of a large number of nesting birds, and always confined to the throat. Possibly they selected this part of the booby plumage as a retreat because it was the only accessible area which afforded shade from the full glare of the equatorial sun."

The following aspects of the bionomics of *O. aenescens* were discussed in Part I: infestation with fungi (Laboulbeniales; p. 141); duration of pupal development (p. 199); and host relations (pp. 222–223 and 250).

Infestation with mites appears to be rare in *O. aenescens*, no cases being recorded thus far. Among the many specimens examined I have only found two females carrying mites, both from St. Croix I. and taken on *Sula leucogaster*. One carried 3 mite clusters: one fixed to the under side of the elbow-shaped vein forming the base of the first basal cell in the left wing; one ventrally near the apex of the abdomen; and one on the under side of the left mid femur, close to the base. The other fly had two clusters: one on the right side of the abdomen, near the apex; and the other dorsally at the anterior margin of the thorax, on the right side in the deep notch between the notum and the occipital margin.

The puparium is as yet undescribed, although Kartman (1949, p. 131) mentioned that he obtained from flies kept in captivity 2

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ventral ano-genital area, ♀, Ponape I., on same host, drawn from fly in alcohol: *ANO*, anal opening; *lo*, lobe on rim of anal sclerite; *SP7*, 7th abdominal spiracle; *VUO*, vulvar opening; **H**, lobe on rim of anal sclerite, ♀, Ducie I., Pacific Ocean, drawn from dry fly; **I**, full-grown larva from fly on *Sula l. leucogaster*, Raroia Atoll, Pacific Ocean; **J**, one of the anchor-tipped hairs of same.

puparia from which adults emerged later. I have seen a newly-laid, apparently full-grown larva (Fig. 88*I*), dirty-white except for the black respiratory cap, which was found by Mr. J.P.E. Morrison in the plumage of *Sula leucogaster* on Raroia Atoll, Tuamotu Group, Pacific Ocean. This is 4 mm. long, 2.8 mm. wide and 2.5 mm. thick. Its shape is that of the puparia known for other species of the genus and it is likewise covered with erect, stiff hairs, which in this species end in a pair of microscopic divergent barbs, so that the hair is anchor-shaped at the tip. The terminal barbs are so minute as to be easily overlooked and the tips on which they are inserted are often broken, so that many hairs have lost them. The integument is also minutely pitted. Both the pits and the hairs are lacking over a ring-like area corresponding to the future circular seam along which the puparium splits when the adult emerges. The apical notch of the respiratory cap is very broad and shallow. On each half of the cap the respiratory pores are scattered rather irregularly, about 40 to 45 on each half, each on a rather wide but low mound.

According to Gressitt (1955), *O. aenescens* is common on red-footed boobies, *Sula sula rubripes*, at Mokapu Point, Oahu, Hawaiian Is. It is also abundant at Kilauea Point Light Station, Kauai I., from November to February, when "their bites inflict painful, long-lasting sores on the personnel of the station." This is the first mention of the species attacking Man.

Affinities. The main characters separating *O. aenescens* from its close ally, *O. spinifera*, are given in the key. The following additional points may be mentioned. Interocular face about $1\frac{1}{2}$ times the width of an eye in ♀, nearly twice that width in ♂ (Fig. 85*C*). First antennal segment incompletely separated behind from the side of the lunula. Transverse depression of postvertex slightly curved and placed below mid-length. Upper orbits slightly longer than in *O. spinifera*, about as long as greatest width of inner orbits, more distinctly grooved transversely. Frontal area and antennae (Fig. 84*C*) as in *spinifera*. Thorax and abdomen (Figs. 88*C–D*) as in that species; lobes on rim of anal sclerite (Figs. 88*G–H*) low, broadly rounded, not triangular nor finger-shaped. In the ♂ the setigerous lobes at the sides of the aedeagus often appear narrower and more rod-like than in *O. spinifera*, but it seems doubtful that the difference is reliable in every case. The microtrichia of the under surface of the wing membrane in the hind part of the combined anal, 3rd posterior and axillary cells, and in the postaxillary cell (indicated by more spaced stippling in Fig. 88*B*), leave a

narrow bare outer marginal strip in the postaxillary cell as well as in the alula. *O. aenescens* averages smaller than *O. spinifera,* the wing being 6.5 to 8 mm. long.

Original description of *O. aenescens:* "Nigro-aenea, subtus cum pedibus sordide testacea; thorace margine antico 3-sinuato, callo humerali pallido spinoso-producto; alis griseo-hyalinis, nervis nigricantibus, transverso-ordinario pone post costae exitum sito. Long. 6 mill. *O. mexicanae* Macq. affinis. Caput horizontale, postice in sinu thoracis arcte receptum, aeneum, glabrum, nitidum; fronte utrinque setis 2 haud validis, distantibus ornata, sulco transverso ab epistomate minus quam a margine postico remoto; ocellis nullis; epistomate linea subarcuata a fronte discreta, horizontali, canalicula media postice in foveam dilatata, impresso, apice exciso, lobis divaricatis; antennis prope sinum lateralem epistomatis insertis, compressis, haud latis, setulosis; genis ante oculos pallide fuscis, pilosulis; palpis vaginatis compressis, epistomatis apicem superantibus, corneis; oculis maximis glabris, ovalibus, orbita inferiore postice subsinuata. Thorax depressus, aeneus, nitidus, antice 3-sinuatus, impressione transversa pone medium distincta, medio interrupta, callo humerali pallido, setis nonnullis ornato; scutello transverso, apice truncato. Alae longae incumbentes, glabrae, griseo-hyalinae; nervis nigro-piceis, corneis, costali cum ramo submarginali cubiti fere in 4:a posteriore alae parte conjuncto ibique desinente, abscissa 2:a sive mediastina quam postcostali haud longiore, 4:a praecedente sesqui, quam ultima fere triplo longiore; mediastino discreto; postcostali medium alae attingente; cubitalis furca ante apicem cellulae humeralis sita, ramis ut etiam brachiali costae approximatis; brachiali ante furcam cubiti spatio membranaceo interrupto, pone nervum transversum ordinarium obsoletiore, apicem alae haud attingente; humerali pone nervum transversum et anali mox pone originem obsoletioribus: cellula discoidali postice aperta; humerali nervo transverso perpendiculari bene discreta; anali aperta; lobo distincto, halteribus parvis, horizontalibus, clava parva, apice truncata. Abdomen rotundum, thorace latius, opacum, medio nitidulum. Pedes omnes distantes, sordide testacei, sensim longiores, nitiduli; femoribus superne parce nigro-setosis; tibiis compressis, muticis, margine exteriore subarcuato; tarsis tibiis brevioribus, articulis deplanatis, posticis articulo 1:o elongato, 5:o unguiculis validis nigris, 3-dentatis, dente basali pallido, pulvillis majusculis, empodio distincto tenui. Pectus subtus medio planiusculum, nitidum, latera versus aenescens; pleuris dorso ante alas conspicuis pro femoribus anticis recipiendis excavatis; prosterno membranaceo." I studied the type at Stockholm in 1933 and found that it agreed in every structural character with the species I had identified previously as *O. erythropsis* Bigot, which name now becomes a synonym. Speiser (1904) concluded from a study of the type of *aenescens* that, although closely related to *O. erythropsis,* it differed in the shape of the postvertex; but the difference is too slight to be of specific value. In the type of *aenescens* the postvertex is divided by a transverse depression into a short, anterior alutaceous portion and a much longer, posterior, smooth and shiny area, exactly as in the type of *erythropsis.* The shape of the occipital margin and of the basal cell are also the same in both types.

Original description of *O. erythropsis* (French text translated): "Long. 6 mm. Antennis fuscis, fuscovillosis. Fusco nigro, thorace nitido; oculis rufis; humeris flavis; thorace et scutello, utrinque, castaneo obscuro limbatis; tibiis sordide rufis, femoribus, superne, tibiis, intus et externe, tarsis, omnino, obscure fuscis; alis infumatis, venis, costali, longitudinalibus 1–4is omnino, 5a et 6a, usque ad transversas nigras, nigris. Antennae brown, with brownish pilosity; thorax very shiny brownish-black; eyes red; frons with two transverse grooves, a rounded pit placed above the epistome [clypeus]; humeri yellowish; sides of thorax and of scutellum with a dark chestnut border; scutellum seemingly bare; abdomen blackish brown, little shiny; legs dull reddish; femora above and inner and outer margins of tibiae and tarsi blackish; some scattering

brown setae on the femora; wings smoky; costa, entire 1st to 4th longitudinal veins, and 5th and 6th as far as the cross-veins, blackish; 1st cross-vein pale; 2nd longitudinal joining the costa about opposite the 1st cross-vein and far from the 3rd longitudinal; the two basal cells very unequal.'' The type was examined by Speiser in 1902. Mr. J.E. Collin, who some years ago studied it again at my request, sent me the following notes, together with some sketches: ''*O. erythropsis* appears to be the same as *diomedeae* of your Table [*P. diomedeae* Coquillett, now considered a synonym of *aenescens*]. There is a specimen of *spinifera* in the [Bigot] collection (the type of *O. courtilleri* Fairm.). Compared with this, *erythropsis* is smaller, and, in addition to the differences mentioned by you, *erythropsis* has base of 2nd basal cell broader and more rounded, and apex squarer than in *spinifera;* in *spinifera* the upper outer angle of 2nd basal cell is acute owing to slope of cross-vein. The apical arms of fronto-clypeus [frons] in *erythropsis* are not quite so broad as in *spinifera*, but are turned outwards at tip and finely sculptured on inner margin very much as in *spinifera.* Palpi not very noticeably shorter. The postvertex is divided as in *spinifera.*'' I have now (1951) been able to see the type myself and to confirm Mr. Collin's findings. The specimen has a slight abnormality in the right wing, an additional cross-vein close to the tip of the first basal cell setting off a supernumerary small cell.

Original description of *P. diomedeae:* ''Head brown; a transversely-oval, elevated, polished, frontal spot reaching slightly below the middle of the front; a transverse parallelogrammatic one occupying the lowest median fourth of the front; orbits elevated and polished; remainder of the front depressed, opaque, gray pruinose; shorter hairs of antennae yellow, the stronger ones dark brown, changing into yellow at their apices; thorax polished brown, the angles yellow, the sides, transverse suture, a spot towards the middle of the thorax from each humerus and a second spot a short distance behind each of these, also two spots in front of the scutellum, opaque, gray pruinose; middle of sternum yellow; scutellum polished dark brown, destitute of bristles, posteriorly truncate and ciliate with very short hairs; abdomen dark brown, opaque, gray, pruinose; wings hyaline, veins brown, the first vein, except its base, usually yellow, last section of the fifth vein and the whole of the sixth except its base, whitish; apex of first vein noticeably before the small crossvein, apex of second vein about twice as far from the apex of the first vein as from tip of the third; legs brown, the lower side of the femora and the tibiae except their outer and inner edges, yellow; length 7 mm.'' Originally described from 4 specimens, it is now represented at U.S.N.M. by the ♂ holotype (No. 4431) and 2 ♂ paratypes. I have studied these several times, reaching the conclusion that they are cospecific with Bigot's *erythropsis* and Thomson's *aenescens.* The wing of the holotype is 7.5 mm. long; that of the two paratypes 8 mm. The third ♂ paratype is now at Stanford Univ., where I saw it in 1953.

Olfersia fumipennis (Sahlberg)

Figs. 83, 84*A*, 89*A–E*, 90*A–G*, 91 and 92

Lynchia fumipennis Sahlberg, 1884, Medd. Soc. Fauna Flora Fennica, **13**, p. 150 (♀ ♂. Finland: 4 ♂ and 2 ♀ cotypes, Thusby, on *Pandion h. haliaetus;* 2 ♂ cotypes, Kuopio. Cotypes ♀ ♂ at University Zoological Museum in Helsingfors and 1 ♂ cotype from Kuopio, at Mus.Comp.-Zoöl., Cambridge, Mass.).

Pseudolfersia fumipennis Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 165; 1907, Ent. News, **18**, p. 104 (synonymy of *Pseudolfersia maculata* Coquillet); 1908, Zeitschr. Wiss. Insektenbiol., **4**, pp. 244 and 303. Williston, 1908, Manual North American Diptera, 3rd Ed., p. 382, fig. 159 (after Washburn, 1905). Johnson, 1922, Psyche, **29**, p. 84 (New Jersey: Cape May and Lahaway, on *Pandion haliaetus caro-*

linensis. Florida: St. Augustine, on *Pandion haliaetus carolinensis*. Louisiana: Sand Point, on *Pandion haliaetus carolinensis*. New Hampshire: Hampton, on *Haliaëtus l. leucocephalus*. Wisconsin: on *Gavia immer* [holotype of *P. maculata* Coquillett, 1899]. Cuba: on *Pandion haliaetus carolinensis*).

Olfersia fumipennis Johnson, 1925, Bull. Northeastern Bird-Banding Assoc., **1**, p. 52; 1925, Occ. Papers Boston Soc. Nat. Hist., **7**, p. 294. Johannsen, 1928, Cornell Univ., Agric. Expt. Sta., Mem. **101**, (for 1926), p. 868 (New York: Clove Valley near Poughkeepsie, on *Pandion haliaetus carolinensis;* Staten Island, on *Pandion haliaetus carolinensis*). Johnson, 1930, Publ. Nantucket M. Mitchell Assoc., **3**, pt. 2, p. 158 (listed for Nantucket, but not taken there). Winn and Beaulieu (revised by Petch and Maltais), 1932, Suppl. to 24th Rept. Quebec Soc. Prot. Plants, p. 90 (Quebec: St. Therese; Joliette). J. Bequaert, 1933, Psyche, **40**, pp. 102 and 104. Spencer, 1938, Proc. Ent. Soc. British Columbia, No. **34**, p. 44 (in part: British Columbia: Kamloops; [not the records from Vancouver, which should be disregarded according to Prof. Spencer, *in litt.*]). Brimley, 1938, Insects North Carolina, p. 390 (North Carolina: Raleigh and Brunswick, on *Pandion haliaetus carolinensis*). J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 320 and 321; 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 82. Guimarães, 1944, Papéis Avulsos Depto. Zool., São Paulo, **6**, No. 16, p. 183, figs. 1–2 (Brazil: Manacapurú, State Amazonas, on *Pandion haliaetus carolinensis*. Larva). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, p. 408, figs. 242–244 (Wisconsin: without precise locality, on *Gavia immer* [holotype of *P. maculata* Coquillett, 1899]. Michigan: Ann Arbor, on *Pandion haliaetus carolinensis*. Minnesota: Itasca Park, on *Pandion haliaetus carolinensis*). Webber, 1950, in Craighead, Insect Enemies Eastern Forests, (U. S. Dept. Agric. Misc. Publ. **657**), (1949), p. 529. Hennig, 1952, Larvenformen der Dipteren, **3**, p. 402. J. Bequaert, 1952, Verh. Naturf. Ges. Basel, **63**, No. 1, p. 219 (West Sumba, Indonesia: Rua, on *Pandion haliaetus cristatus*).

Pseudolfersia maculata Coquillett, 1899, Canad. Entom., **31**, p. 336 (no sex. Wisconsin: on *Gavia immer*, holotype. Also 8 paratypes without locality, on *Pandion haliaetus carolinensis*. Holotype ♀ from Wisconsin, at U.S.Nat.Mus., No. 4211; of the 8 paratypes, 7 [6 ♀, 1 ♂] also at U.S.Nat.Mus.). Johnson, 1900, 27th Rept. New Jersey Bd. Agric., (for 1899), p. 699 (New Jersey: Cape May and Lahaway, on *Pandion haliaetus carolinensis*). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Johnson, 1910, Ann. Rept. New Jersey State Mus., (for 1909), p. 814; 1913, Bull. Amer. Mus. Nat. Hist., **32**, p. 90 (Florida: St. Augustine, on *Pandion haliaetus carolinensis*). Lochhead, 1915, **7th** Rept. Quebec Soc. Prot. Plants, p. 130. Davis, 1922, Proc. Staten Island Inst. Arts Sci., **1**, p. 65 (New York: Staten Island, on *Pandion haliaetus carolinensis*). Bird, 1927, Jl. New York Ent. Soc., **35**, p. 102 (puparium).

Psuedolfersia maculata Washburn, 1905, 10th Ann. Rept. State Entom. Minnesota, (also as Agric. Expt. Sta., Minnesota, Bull. **93**), p. 159, fig. 155.

Pseudolfersia mycetifera Speiser, 1905, Zeitschr. Syst. Hym. Dipt., **5**, p. 539 (♂. Arabia: Senafir or Sanafir I., in the northern Red Sea, 27° 56′ N., 34° 43′ E., on "Adler" [probably *Pandion haliaetus*]. Type in Vienna Mus.).

Olfersia fossulata Peters, 1936, Bird-Banding, **7**, p. 13 (Virginia: on *Pandion haliaetus carolinensis*). Not of Macquart, 1843.

Pseudolfersia sp. Brues and Melander, 1932, Bull. Mus. Comp. Zool., **73**, p. 346,

fig. 666 ("after Lugger," copied from Williston, 1908); 1954, *Op. cit.*, **108**, p. 385, fig. 666.

Distribution and Specimens Examined. Dominion of Canada. British Columbia (recorded by Spencer, 1938): Osoyoos Lake, 49° 2′ N., on *Pandion haliaetus carolinensis* (J. Poole); Kamloops, 50° 41′ N. (J. McT. Cowan and G.J. Spencer). — Quebec (recorded by Winn and Beaulieu, 1932; Lochhead, 1915): Joliette, 46° 3′ N., June, on *Pandion haliaetus carolinensis* (J. Ouellet).

United States. Arizona: Picacho Lake, Pinal Co., on *Pandion haliaetus carolinensis* (M.H. Frost, Jr.). — Florida (recorded by Johnson, 1913): without precise locality (C.J. Maynard); St. Augustine, Saint Johns Co., on *Pandion haliaetus carolinensis* (C.W. Johnson); Lake Flirt, on *Pandion haliaetus carolinensis* (R.H. Howe, Jr.). — Georgia: Savannah, Chatham Co., on *Pandion haliaetus carolinensis* (P.W. Fattig). — Kansas: Pratt Co., on *Pandion haliaetus carolinensis* (Bunker). — Louisiana (recorded by Johnson, 1922): South Point, Plaquemines Parish, on *Pandion haliaetus carolinensis*. — Massachusetts: Monomoy Point, Chatham, Barnstable Co., on *Pandion haliaetus carolinensis* (J.D. Smith); Chatham, Barnstable Co., on *Pandion haliaetus carolinensis*, April 24 (R.P. Dow); Fitchburg, Worcester Co., on *Pandion haliaetus carolinensis* (J.A. Peck). — Michigan (recorded by MacArthur, 1948): Ann Arbor, Washtenaw Co., on *Pandion haliaetus carolinensis*, April 22 (U.S.Nat.Mus.). — Minnesota (recorded by MacArthur, 1948): Itasca Park, Clearwater Co., on *Pandion haliaetus carolinensis*, May 15, (H.H. Knight and W.A. Riley). — New Hampshire (recorded by Johnson, 1922): Hampton, Rockingham Co., on *Haliaeëtus l. leucocephalus* (S.A. Shaw). — New Jersey (recorded by Johnson, 1900, 1922): Cape May, Cape May Co., on *Pandion haliaetus carolinensis* (H. Skinner; W. Stone); Lahaway near New Egypt, Ocean Co., on *Pandion haliaetus carolinensis* (J.T. Brakeley); Ramsey, Bergen Co., on *Pandion haliaetus carolinensis* (C.E. Sleight); Sandy Hook, Monmouth Co., on *Pandion haliaetus carolinensis* (T.D. Carter). — New York (recorded by Davis, 1922; Johannsen, 1928): Staten Island, on 2 *Pandion haliaetus carolinensis*, May 20 (J.P. Chapin) and Sept. 1 (W.T. Davis); Clove Valley near Poughkeepsie, Dutchess Co., on *Pandion haliaetus carolinensis*, May 2 (H. and J.B. Bird); Orient, Long Island, on *Haliaeëtus l. leucocephalus* and *Pandion haliaetus carolinensis* (R. Latham); Albany, on *Pandion haliaetus carolinensis*, Sept. 19. — North Carolina (recorded by

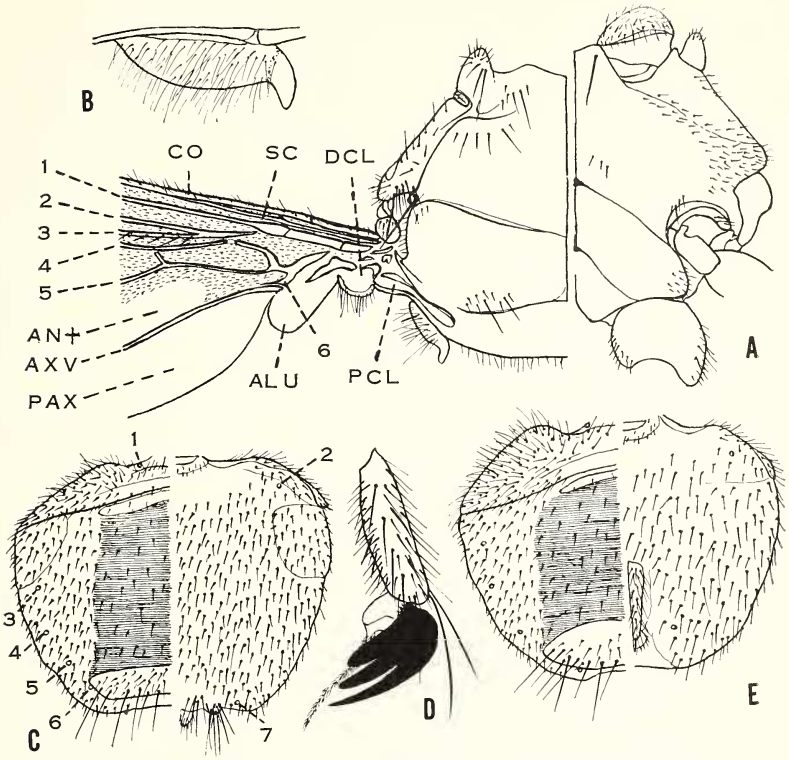

Fig. 89. *Olfersia fumipennis* (Sahlberg), ♀ and ♂, Huntsdale, Pa., on *Pandion haliaetus carolinensis:* **A**, thorax dorsally and ventrally, and basal area of left wing, ♀: *ALU*, alula; *AN+*, combined anal, 3rd posterior and axillary cells; *AXV*, axillary vein; *CO*, costa; *DCL*, upper calypter; *h*, humeral cross-vein; *PAX*, postaxillary cell; *PCL*, lower calypter; *SC*, subcosta; *1, 2, 3, 4, 5* and *6*, 1st, 2nd, 3rd, 4th, 5th and remaining stump of 6th longitudinal veins; **B**, left metanotal pleurotergite, ♀; **C**, abdomen dorsally and ventrally, ♀, the spiracles numbered 1 to 7; **D**, distitarsus and claw of hind leg, ♀; **E**, abdomen dorsally and ventrally, ♂.

Brimley, 1938): Four Oaks, Johnson Co., on *Haliaeëtus l. leucocephalus* (Mrs. R.C. Simpson); Raleigh, Wake Co., on *Pandion haliaetus carolinensis* (H.H. Hume); Winnabow, Brunswick Co., on *Pandion haliaetus carolinensis* (R.W. Leidy). — Ohio: Greenville, Darke Co., on *Pandion haliaetus carolinensis* (R. Rausch). — Oregon: Malheur National Wildlife Refuge, Burns, Harney Co., on *Pandion haliaetus carolinensis,* April 29 (G. Benson). — Pennsylvania: Philadelphia, in Zoological Garden, on *Pandion haliaetus carolinensis,* Oct. 1 (W. Huber); Reading, Berks Co., May 3, on *Pandion haliaetus carolinensis* (L.S. Dillon); Barree,

Huntingdon Co., on *Pandion haliaetus carolinensis* (C.W. Johnson); Huntsdale, Cumberland Co., on *Pandion haliaetus carolinensis* (B. Donley); Chester Co., on *Pandion haliaetus carolinensis* (R.M. Stabler). — TENNESSEE: Norris, Anderson Co., on *Pandion haliaetus carolinensis*, Sept. 14 (A.R. Cahn). — TEXAS: Valentine, Jeff Davis Co., on *Pandion haliaetus carolinensis* (P.A. Readio). — VERMONT: Windsor, Windsor Co., on *Coragyps a. atratus*, June 24 (J.D. Smith). — VIRGINIA (recorded by Peters, 1936): Onley, Accomac Co., on *Pandion haliaetus carolinensis* (H.S. Peters); Hog I., Accomac Co., on *Pandion haliaetus carolinensis* (C.L. Sperry); Virginia Beach, Princess Anne Co., on *Haliaeëtus l. leucocephalus*, Nov. 13. — WISCONSIN (recorded by Coquillett, 1899, as *P. maculata;* C.W. Johnson, 1922; MacArthur, 1948): without more definite locality, on *Gavia immer*, April 15, 1893; according to MacArthur (1948), possibly on the subsp. *elasson* (♀ holotype of *P. maculata* Coquillett).

MEXICO: San Benito Is., Baja California, on *Pandion haliaetus carolinensis* (G.P. Ashcraft).

BRITISH HONDURAS: without precise locality or host (Newham. — Received from P.A. Buxton); Turneffe Cay, on *Pandion haliaetus carolinensis* (S.M. Russell).

ANTILLES. BAHAMAS: Fish Cay, Crooked I., on *Pandion haliaetus ridgwayi* (H.S. Peters); W. Caicos I. (H.S. Peters). — CUBA (recorded by Johnson, 1922): without precise locality, on *Pandion haliaetus carolinensis* (J. Gundlach).

VENEZUELA: Puerto La Cruz, D.F., Caracas, on *Pandion haliaetus carolinensis* (E.G. Holt).

BRAZIL (recorded by Guimarães, 1944): Rio de Janeiro (A. Corrêa); Manacapurú, State Amazonas, on *Pandion haliaetus carolinensis* (C. Worontzow Daschkow).

O. fumipennis is nearly world-wide in distribution, occurring wherever its host, the osprey, is found, or at any rate, breeds. That it is better known from the New than from the Old World is due to the vagaries of collecting. In Europe, it was originally described from two localities in Finland; but I have also seen it from Walowiki, former Government Woronesch, USSR (W. Velitchkovsky. — Vienna Mus.). As *Pseudolfersia mycetifera* is a synonym, the Red Sea may be added to the range; moreover, I have seen a male from Kosseir, on the west coast of the Red Sea (Klunzinger. — Stuttgart Mus.). Specimens were taken from the Indonesian race of the osprey on Sumba (or Sandalwood) I. by the Buhler and Meyer Expedition. The northward extension of this fly on

both sides of the Atlantic is noteworthy. In Finland it reaches 62° 50′ N. and in North America about 50° 40′ N.

Known American Hosts of *O. fumipennis* (verified individual records in parentheses). Gaviiformes (1): *Gavia immer* (1). Falconiformes (46): *Coragyps a. atratus* (1); *Haliaeëtus l. leucocephalus* (4); *Pandion haliaetus carolinensis* (40); *P. haliaetus ridgwayi* (1).

In the Old World, *O. fumipennis* has only been taken on 2 races of *Pandion haliaetus.*

Bionomics. *O. fumipennis* uses the osprey or fishhawk, *Pandion haliaetus*, as a regular breeding host. This bird, the only representative of a distinct family of diurnal raptores, occurs in several races over much of the surface of the earth. J.L. Peters (1951) recognizes five geographical races and *O. fumipennis* has now been taken on four of these: in Europe on *P. h. haliaetus;* in North and South America on *P. h. carolinensis;* in the Bahamas on *P. h. ridgwayi;* and in Indonesia on *P. h. cristatus* (= *P. h. melvillensis*). This is one of the strictest cases of specificity known among the Hippoboscidae. Of 47 verified American host records, 41, or 87.2 per cent, are from osprey, 4 of the remaining being from American bald eagle, *Haliaeëtus leucocephalus*, one from a vulture, *Coragyps atratus*, and one from loon, *Gavia immer*.[61]

While the 4 records from bald eagle and the one from loon are clearly due to accidental straggling, there is a possible explanation for their occurrence. Mr. K. MacArthur (*in litt.*, 1956) called my attention to the following account of the habits of the bald eagle by T.S. Roberts (1932, *Birds of Minnesota*, **1**, p. 337), which, he suggests, might provide an answer to the problem. "It [the bald eagle] is by nature a robber and, unless forced by adverse conditions, will not put up a fair fight for its subsistence. The osprey, an excellent fisherman, and too small to defend itself against such a burley highwayman, is the special object of its nefarious attacks. Both birds locate their nests near large bodies of water. While the osprey is patrolling the lake looking for food, the eagle sails high overhead watching proceedings. When the osprey plunges, the eagle is all attention and, as soon as the captured fish has been carried some distance above the water, swoops

[61] Professor G.J. Spencer informs me that the two records of *O. fumipennis* from *Melospiza lincolnii gracilis* and *Vermivora celata lutescens*, at Vancouver, which he published in 1938, should be disregarded. The host labels must have been written by error.

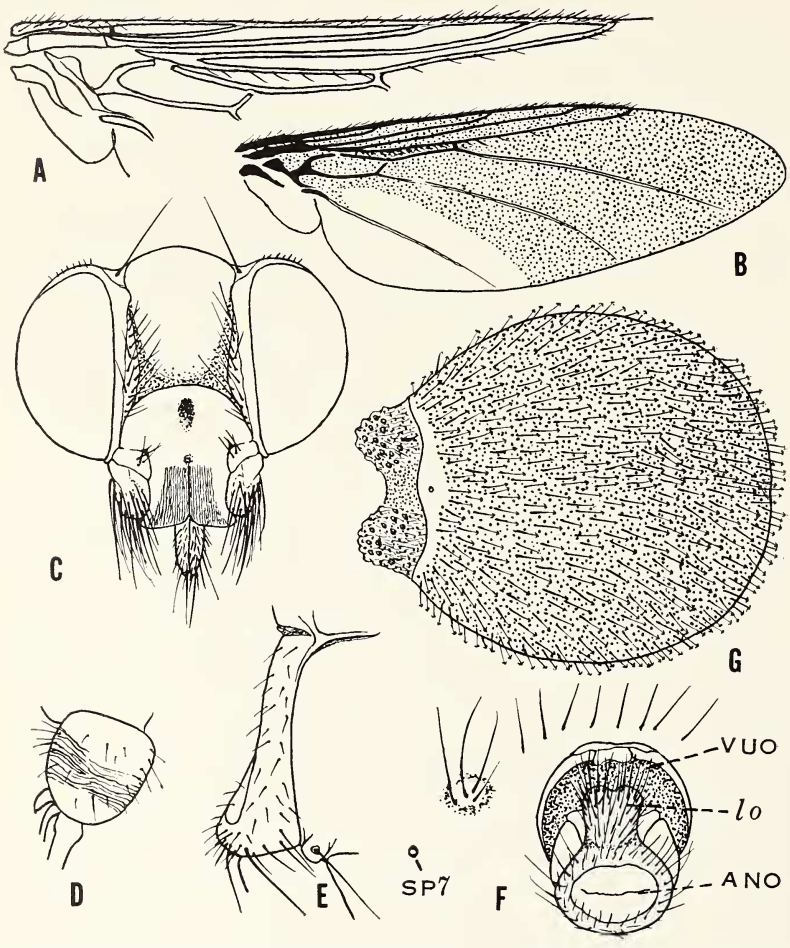

Fig. 90. *Olfersia fumipennis* (Sahlberg), ♀, Huntsdale, Pa., on *Pandion haliaetus carolinensis:* **A**, anterior part of wing, the microtrichia omitted; **B**, wing; **C**, head; **D**, tegula; **E**, dorsal aspect of left anepisternum; **F**, ventral ano-genital area, drawn from fly in alcohol: *ANO*, anal opening; *lo*, fused lobes on rim of anal sclerite; *SP7*, 7th abdominal spiracle; *VUO*, vulvar opening; **G**, puparium.

down on the smaller and heavily laden bird, the assault forcing the release of the fish, which by a quick dash the eagle seizes in its claws before it reaches the water. The osprey is left to make another hunt, which may end the same way. During a winter spent by the writer along the east coast of Florida, where both ospreys and eagles were common, this robbing of the ospreys was a daily, sometimes an hourly sight. . . . At Lake Itasca [Minnesota], where there are aeries of both species, this merciless plundering can be witnessed daily. One morning an eagle was seen to rob an osprey of three of its five catches, the other two being saved while the bandit was busily feeding its young with its ill-gotten quarry." In his letter Mr. MacArthur offers the following comments on this article: "In diving onto the osprey to force the dropping of his catch, there are undoubtedly times when the bodies of the two birds are, momentarily at least, in direct contact, and it is not difficult to understand how an actual transfer of an occasional louse-fly, from osprey to eagle could occur. Likewise, although mating pairs of both osprey and bald eagle are known to utilize their respective nesting sites, ordinarily year after year, adding to them until they become quite cumbersome affairs, nevertheless, according to Roberts (*Op. cit.*, p. 349), sometimes the ospreys in a certain area may be subject to such continual thievery on the part of the bald eagle as to make it difficult or impossible for the osprey to maintain itself. If the osprey abandons such areas, the bald eagle might in some instances take over the deserted nesting sites, either an exceptionally tall tree or a rocky prominence, as a point of vantage for resting and observation because it offers the only commanding view of the surrounding country. Under such circumstances individuals of *Olfersia fumipennis*, newly emerged from abandoned nest debris of the osprey, would have no alternative but to seek temporary refuge on the body of the new tenant. Similarly with respect to the straggling of *O. fumipennis* on loon, it is conceivable that the osprey could, without too much difficulty, unwittingly disengage some of its flies during its frequent swift plunges into the water, particularly if flies chance to be on the feather surface at the moment of impact. If this were to occur, an osprey louse-fly would clamber onto the body of any swimming bird that happened to be in the vicinity, where it would be isolated from the normal host and either have to adapt itself temporarily to the new host or perish. From my own observations in the Great Lakes area, loons and ospreys are frequently the only aquatic bird life in evidence on the more northern lakes." Another ecological fac-

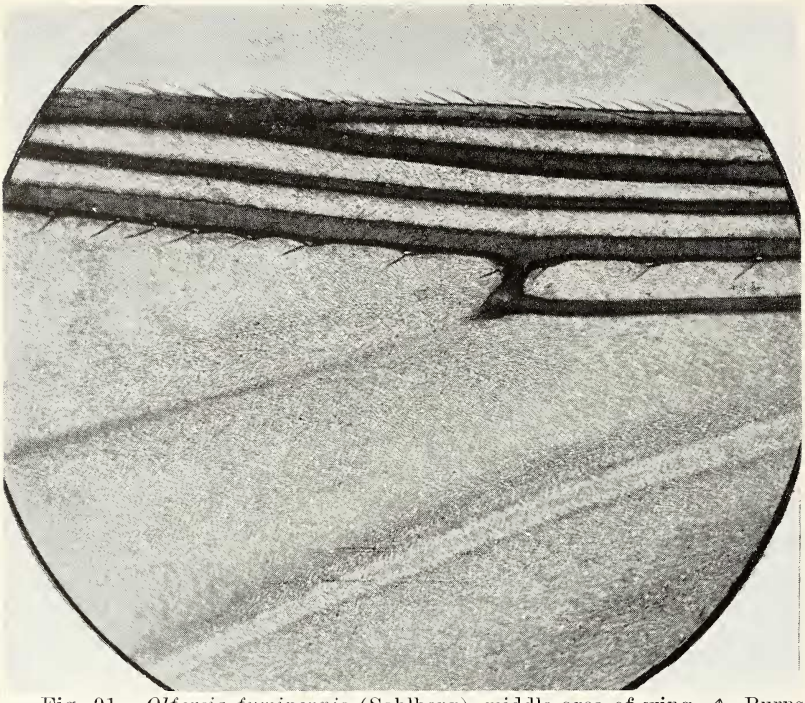

Fig. 91. *Olfersia fumipennis* (Sahlberg), middle area of wing, ♂, Burns, Oregon, on *Pandion haliaetus carolinensis*. Photograph by Mr. K. MacArthur (1948, fig. 242).

tor possibly to be considered is that osprey, bald eagle and loon nest in a similar environment close to permanent open water. Bald eagle and osprey, moreover, sometimes nest close to each other and both build nests of the same type some distance above ground, preferably in trees.

In Part I I have given some information on infestation with fungi of the order Laboulbeniales (p. 141) and with mites (p. 160), as well as on the host relations (p. 316). A second case of mite infestation concerns a ♀ from Norris, Nebr., on *Pandion haliaetus carolinensis*, with a ♀ mite without eggs attached to the left side of the abdomen, near the tip.

Guimarães (1944) figures a newly voided, presumably full-grown larva, obtained from a fly taken at Manacapurú on *Pandion haliaetus carolinensis*. This he describes as follows (translated from the Portuguese): "It is oval in shape, like the previously known larvae, about 4.5 to 5 mm. long and 3.5 mm. wide. Posteri-

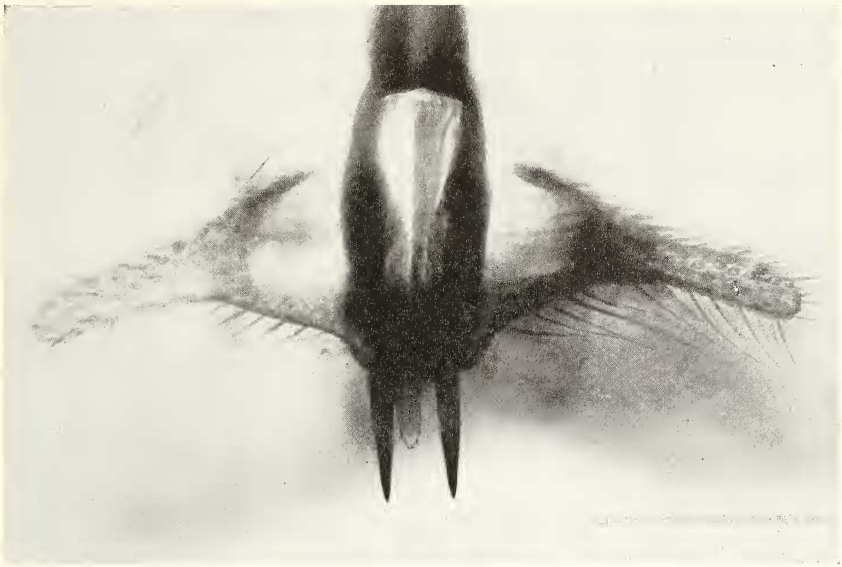

Fig. 92. *Olfersia fumipennis* (Sahlberg), ♂ terminalia, extended, Burns, Oregon, on *Pandion haliaetus carolinensis*. Photograph by Mr. K. MacArthur (1948, fig. 244).

orly the body ends in a single stigmatic cap, darkly pigmented, with the 2 polypneustic lobes, on each side with 50 to 60 pores. The pores are placed on slight cuneiform elevations surrounded by minuscule depressions. Between the 2 polypneustic lobes lies a deep transverse excavation, simulating an opening and with a small elevation in the center; the stigmatic cap is finely granulose above and below this excavation. On the ventral side of the larva, close to the stigmatic cap, the middle line shows a small opening surrounded by a darkly pigmented ring, which should be the anal opening. . . . At the opposite end lies the mouth, as previously recognized by Pratt in *Melophagus ovinus*, on a small elevation with a projection on each side. Except over the stigmatic cap and over a ring-like anterior zone, the larva is covered with very typical spines, but their tips are anchor-shaped. Between the spines, the cuticle of the larva shows small circles. In the spine-free, ring-like zone the suture along which the puparium will break open to release the adult, is partially visible. Likewise, a transverse, very conspicuous line, running close to the mouth, may be traced, dividing the operculum into halves.'' I have seen 2 puparia deposited by flies from Chester Co., Pa., on *Pandion haliaetus*

carolinensis, which agree perfectly with Guimarães' account and his measurements (Fig. 90*G*). The late Henry Bird, of Rye, N.Y., was the first to obtain a puparium of this species from a fly taken on *Pandion haliaetus carolinensis*, near Poughkeepsie, N.Y. He exhibited the fly and its offspring on December 1, 1925, at a meeting of the New York Entomological Society, calling attention particularly to the "anchor-like setal hooks" covering the puparium. This appears from 2 letters which he wrote me at that time (Nov. 30, 1925, and Feb. 5, 1926). In one of these he stated that his talk before the Society had to do "with the evagination of a puparium so nearly the size of the mother, and the setal hooks thereof, which upon my assumption are for anchoring it among the feathers of the host, rather than for the possibility of its being placed in the nest." Although the talk elicited some comments from those present, the published minutes of the meeting (1927, Jl. New York Ent. Soc., **35**, p. 102) unfortunately omit these interesting details.

Affinities. As will be discussed in detail for *O. bisulcata*, that species forms a compact group of close allies with *O. fumipennis* and *O. fossulata*. Few reliable diagnostic characters can be added to those given in the key. The 2nd basal cell is relatively long, more than half the length of the 1st basal cell, in *O. fumipennis*. The setae on the 3rd longitudinal vein are better developed than in the other two species and occur as a rule over the entire length of the vein, although some of them may be lost occasionally in old flies. In all 3 species the 1st antennal segment is divided from the basal area of the frons by an incomplete suture, interrupted medially; the inner, deeper section of this suture sends off a short, superficial, oblique branch, the remnant of the transverse suture which in most Hippoboscidae separates the lunula from the frons proper. In *O. fumipennis* (Fig. 84*A*) this rudimentary suture is somewhat better defined than in its two allies.

Original description of *L. fumipennis:* "Nigro-aenea, nitida, thoracis maculis nonnullis pruinosis ventreque opacis, cinereis, pulvillis unguiculorum pallide flavis, fronte maculis duabus triangularibus piceo-rufis, vertice nitidissimo; hypostomate medio bifoveolato; alis magnis, fumatis, limbo angustissimo apicali et interiore pallidiore, basi punctis et lineolis hyalinis. Long. 4 lin. [= 8.7 mm.]. — *Mas:* segmento ultimo ventrali apice late emarginato, appendicibus duabus cylindricis pilosis armato; valvulis genitalibus corneis, a basi latiore subito angustatis, deinde linearibus acuminatis, retrorsum curvatis. — *Femina:* abdomine lateribus utrinque lobato, apice emarginato, segmento ultimo ventrali basi crista transversali fere semicirculari munito, apice appendice parva squamiformi armato. — Species magna, nigra, metallice splendens, pedibus concoloribus, alis nigrofumatis inter alias Hippoboscidas in avibus hospitantibus insignis. — Caput porrectum, deplanatum, nigro-aeneum,

politum; clypeo apice leviter emarginato, supra antice longitudinaliter dense striato, linea media distincta, postice foveis duabus, posteriore majore instructo, basi linea profunda arcuato terminato; fronte utrinque ad oculis plaga triangulari submembranacea, intus callo lineari terminata, piceo-rufa; temporibus angustis, holosericeis, seta valida armatis; ocellis nullis. Antennae in fovea frontali juxta oculos suboccultae, squamiformes, nigro-aeneae, multisetosae. Palpi exarticulati valvuliformes, obtusiusculi, pilosi, vaginae instar haustellum amplectantes. Haustellum filiforme absque proboscide terminali, nigrum. Oculi magni, piceo-nigri. Thorax capite plus duplo latior, aeneo-niger, nitidus, maculis parvis cinerascentibus opacis lateralibus variegatus; sulco transversali medio interrupto satis distincto; supra subtiliter strigulosopunctatus, medio linea lata subelevata laevi, antice et postice setis nonnullis nigris munitus; lateribus pone angulos anticos callosos acute incisis. Stigma in ipsa incisura positum, transversim lineare. Scutellum transversum, apice truncatum, fulvo-ciliatum, nigro-aeneum, nitidum, sublaeve. Metanotum angulis posticis appendiculo parvo pallido munitis. Abdomen in mare transversim rotundatum, in femina paullo longius, utrinque ante medium obtuse sublobatoproductum in utroque sexu nigrum, pubescens, supra setis nonnullis nigris munitum. Alae subcoriaceae, abdomine plus quam duplo longiores, quam in *Hippobosca* distincte angustiores, apice obtuse rotundatae; nigro-fumatae, venis nigricantibus; costali longe pone medium extensa, breviter ciliata; vena mediastina tenui cum costali paullo ante ejus medium confluente; subcostali acute elevata, recta, paullo pone initium partis tertiae ultimae venae costalis incurrente; area costali valde angusta, antice ad initium venae mediastinae venula obsoleta transversali divisa; vena prima longitudinali e subcostali egrediente, mox pone basin puncto hyalino interrupta, deinde in ramis duobus fere parallelis rectis furcata, ramo anteriore seu radiali paullo ante, posteriore seu cubito in ipso apice costae incurrente; vena secunda longitudinali seu brachiali basi incrassata, deinde anguste interrupta, et sigmoidea-flexa, dein bifurcata, ramis valde divaricatis, anteriore basi versus marginem anticum directo, deinde valde curvato et juxta furcam cubiti puncto albido-hyalino interrupto, subrecto, pone apicem alae in margine postico incurrente, ramo posteriore leviter curvata, prope medium marginis posticis alae in margine incurrente; vena transversali ordinaria brevi, perpendiculari; area discoidali basi obtuse rotundata, postice vena obliqua transversali subinterrupta terminata; vena transversali posteriore nulla; vena anali e radicibus duabus orta, prima e basi brachii excurrente, secunda e basi alae egrediente, anguste interrupta; praeterea in alis venis tribus spuriis seu plicis observandis, prima ante venam analem, secunda et tertia prope basin alae, subparallelis, loco venae axillaris; lobo basali brevi, incisura acuta terminato; limbo toto alae ab apice costae valde angusto magis hyalino. Squamae sub alis brevissimae, rudimentariae, pallidae. Halteres sub angulo postico metanoti occulti, albido-flavi. Pedes validi, aeneo-nigri, antici magis quam postici a mediis remoti, pallidopubescentes et nigro-pilosi; coxis antice apice longe nigro-ciliatis, tibiis omnibus extus carinatis; tarsorum articulis tribus intermediis brevissimis, posticorum articulo basali insequentibus tribus simul sumtis longiore; unguiculis nigris, validis, curvatis, apice acute tridentatis, dente interiore pallidiore; pulvillis duobus squamiformibus, pallide flavis; empodio filiformi nigro. Abdomen nigrum, opacum, fusco pubescens, ventre pallidiore, suturis segmentorum obsoletis, dorso magis nitido, basi transversim carinato-elevato.'' The type specimens are now in the University Zoological Museum in Helsingfors (Helsinki). Through the kindness of Dr. Richard Frey, I was able to study two male cotypes from Kuopio and Thusby, showing no appreciable difference from the American flies taken on osprey. The male from Kuopio was presented by Dr. Frey to the Mus. of Comp. Zool.; its wings are 8.8 mm. long.

Original description of *P. maculata:* ''Front [mediovertex] yellowish-brown, the polished lateral margins and vertical triangle dark brown, the latter tapering anteriorly, broadly rounded at the tip, almost reaching the lower end

of the front, a black bristle each side of the vertex and a row of smaller yellow ones on each side of the lower two-thirds of the front inside of the polished lateral margins; clypeus [frons] brown, yellowish medially, polished, noticeably longer than broad, notched in the middle of the apex and sulcate in the middle, the sulcus terminating in a deep fovea near the base of the clypeus; antennae brown, subovate but flattened above, lying in deep grooves, not reaching apex of the clypeus [frons], polished except the inner portion of its upper side which is opaque gray pruinose, bearing toward its apex a few yellow hairs and many long black bristles; palpi brown, projecting slightly more than their greatest width beyond the apex of the clypeus; under side of the head brown, a yellow median longitudinal sulcus, and a rather large white lobe at its anterior end. Thorax dark brown, polished, the humeral tubercles apically yellow, a spot at inner side of each, another a short distance back of it, a stripe reaching from the prothoracic stigmata to base of wing, the transverse suture and a pair of spots on the posterior end of the thorax opaque gray pruinose, no median longitudinal sulcus, the transverse sulcus interrupted in the middle; pleura thinly gray pruinose except three spots along the suture in front of wings, sternum polished except its extreme anterior end which is gray pruinose; scutellum polished brown, truncate posteriorly, bare except a short pubescence along the posterior margin. Abdomen opaque grayish brown, the apex and venter yellow. Wings smoky brown, apex of auxiliary vein [subcosta] slightly beyond apex of second basal cell, that of first vein slightly beyond apex of first basal cell, of the second vein nearly midway between the apices of the first and third veins; first two sections of fourth vein subequal in length. Legs polished brown, front coxae anteriorly opaque gray pruinose, pulvilli yellow, basal tooth of each tarsal claw yellowish. Length 7 to 8 mm.'' I have examined the ♀ holotype and 7 paratypes (6 ♀ and 1 ♂) several times at the U.S.Nat.Mus. I could find no character to separate them from the European type of *O. fumipennis* and I consider them cospecific. The wing of the holotype is 8 mm. long.

Original description of *Pseudolfersia mycetifera* (translated from the German): ''Length, 7.5 mm.; from anterior margin of mouth to hind margin of scutellum, 4 mm. The species differs from all others in the genus in the pale color, being uniformly brownish-yellow, with paler legs and grayish-brown abdomen. The head is shaped exactly as in *P. aenescens* Thomson; the antennal appendages are not darker than the remainder of the head; the clypeus [frons] has a narrow dark-brown margin. The humeral callosities are pointed, directed straight forward and a little paler than the surface of the thorax, but the scutellum concolorous with the thorax. The legs and ventral side are paler brownish-yellow; only the terminal segments of the tarsi and the hind metatarsi darker. The wings are very slightly brownish, with russet-brown veins; second basal cell nearly half as long as the first; second basal cross-vein (''hintere Querader'') slightly oblique. Abdomen with the narrow [short] basal segment brownish-yellow, hardened and sclerotized; integument elsewhere soft, grayish-brown, also at the anal and genital openings, without harder sclerotized areas.'' Speiser also noted on the abdomen of the type clusters of fungi which he referred correctly to Laboulbeniales. Through the courtesy of the authorities of the Vienna Museum and the kind assistance of Dr. Fred Keiser, of Basel, I have recently been privileged to examine the male holotype, preserved in alcohol. The wing is nearly 9 mm. long. I could find no structural character separating it from specimens of *Olfersia fumipennis*, from ospreys. It should be pointed out particularly that the head is not shaped as in *O. aenescens*, which has much enlarged upper orbits, the combined vertex and mediovertex divided by a curved, transverse depression, a wide interocular face and differently shaped apical lobes of the frons (Fig. 85*C*). None of these features are present in the type of *mycetifera*, which agrees instead with *O. fumipennis* (Fig. 90*C*). Most of the *O. fumipennis* I have seen are almost completely fuscous-black, usually with a few, small paler brown areas; some specimens, however, are more ex-

tensively mahogany-brown and a few from North American ospreys are scarcely darker on head, thorax and legs than the type of *mycetifera*. As shown in Part I (p. 139), Speiser was correct in interpreting as Laboulbeniales the peculiar fungous growths he noticed on the type of his *mycetifera*.

Olfersia bisulcata Macquart

Figs. 86*A–B* and 93*A–I*

Olfersia bisulcata Macquart, 1847, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1846), p. 111; Pl. 6, fig. 12 [1847, Dipt. Exot., Suppl. **2**, p. 95; Pl. 6, fig. 12] (no sex; no host. Chile. Type ♀ from Bigot Coll., now in J.E. Collin Coll.). J. Bequaert, 1933, Psyche, **40**, pp. 102 and 104; 1933, Rev. Chilena Hist. Nat., **37**, p. 164; 1938, Carnegie Publ. No. **499**, p. 227. Martorell, 1939, Jl. Agric. Univ. Puerto Rico, **23**, p. 221. J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 81. Cooper, 1942, Amer. Philos. Soc. Yearbook for 1941, p. 125 (Panama: on "*Catharista urubu*" [=*Coragyps a. atratus*]. Chromosomes); 1944, Genetics, **29**, p. 538 (Panama: Orchid I. in Gatun Lake, on "*Catharista urubu*" [=*Coragyps a. atratus*]. Chromosomes). Stuardo, 1946, Catálogo Dípteros Chile, p. 187. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. de Buen, 1950, An. Inst. Biologia, México, **21**, pt. 2, p. 416 (México: Sa. Rosa, Comitán, State Chiapas, on *Sarcoramphus papa*). J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, (for 1950), p. 9. Makino, 1951, Atlas of Chromosome Numbers in Animals, p. 212. White, 1954, Animal Cytology Evolution, 2nd Ed., p. 223.

Pseudolfersia bisulcata Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 179 (type); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 189 and 195 (copy of description).

Olfersia vulturis van der Wulp, 1903 Biol. Centr.-Amer., Diptera, **2**, p. 429; Pl. 13, figs. 1-1*a* (types doubtfully given as ♀. Costa Rica: Río Sucio, on vulture. Cotypes ♀ ♂ at Brit.Mus.). J. Bequaert, 1926, Medical Rept. Hamilton Rice 7th Exped. Amazon (1924–25), p. 240. Ferris, 1928, Ent. News, **39**, p. 36, figs. *A–B* (Mexico: San Blas, State Nayarit, on "*Catharista urubu*" [=*Coragyps a. atratus*]. Larva). J. Bequaert, 1932, Psyche, **38**, (for 1931), pt. 4, p. 190; 1933, Carnegie Publ. No. **431**, p. 570. Dunn, 1934, Psyche, **41**, p. 175 (Panama: Camp Pital, Chiriqui Prov., on "*Catharista urubu*" [=*Coragyps a. atratus*]).

Pseudolfersia vulturis Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 264 (types ♀ ♂). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 179; Pl. 27, fig. 4; Pl. 28, fig. 2 (Brazil: State Goyaz; Rio de Janeiro. On *Cathartes urubutinga*, "*Catharista atratus* var. *brasiliensis*" [=*Coragyps atratus foetens*], *Cathartes* "*aura*" [=*C. aura ruficollis*], and *Gypagus papa*" [=*Sarcoramphus papa*]). Murphy, 1921, Comp. Administr. Guano, **12**a Mem. del Directorio, Lima, p. 113 (Peru: Central Chincha I., on *Cathartes aura* [*jota*]; 1925, Bird Islands of Peru, p. 250. Ad. Lutz and Nuñes-Továr, 1928, Estudios Zoología Parasitología Venezolanas, p. 9 (Venezuela: on 2 species of vultures). Carbonell, 1938, Parasitología en Venezuela y los Trabajos del Dr. M. Nuñez-Továr, p. 251. Schuurmans Stek-

hoven, 1952, Beiträge zur Fauna Perus, **3**, Wissensch. Bearbeit., pp. 92 and 101 (Peru: Hacienda Huayuri, on vulture).

Pseudoolfersia vulturis Vogelsang, 1936, Rev. de la Policlinica, Caracas, **6**, No. 31, p. 2.123 (Venezuela: Maracay, on "*Cathartes urubu*" [= *Coragyps atratus foetens*]).

Pseudolfersia vulturus Bodkin, 1919, Brit. Guiana Dept. Sci. Agric., Rept. for 1917, p. 62 (British Guiana: N.W. District, on "*Catharista urubu*" [= *Coragyps atratus foetens*]). Cleare, 1919, Brit. Guiana Med. Annual for 1919, 22nd Year, Demerara, p. 70 (same record).

Pseudolfersia mexicana Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 179 (Mexico: specimen labelled "*mexicana*" from Bigot Coll., now in J.E. Collin Coll; [this is not Macquart's type]); 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Not *Olfersia mexicana* Macquart, 1843, which is *Lynchia nigra* (Perty).

Pseudolfersia (*Feronia*) *spinifera* Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 265 (in part: only specimen from Pará, Brazil, on "*Catharista urubu*" [= *Coragyps atratus foetens*]). Not *Feronia spinifera* Leach, 1817.

Olfersia spinifera Dunn, 1934, Psyche, **41**, p. 175 (Panama: Camp La Vaca, Chiriqui Prov., on *Sarcoramphus papa*). Not of Leach, 1817.

Olfersia sp. Darling, 1912, Bull. Soc. Path. Exot., Paris, 5, p. 71 (Panama: Ancon, on *Cathartes a. aura*).

Olfersia diomedeae Falcoz, 1930, Encyclop. Entom., Sér. B, Diptera, **5**, (for 1929), p. 46 (in part: only specimens from Venezuela: Lower Sarare). Not of Coquillett, 1901.

Distribution and Specimens Examined. United States. Louisiana: New Orleans, ♂ in a plane arriving from Balboa, Panama, Feb. 19, 1949 (U.S.Publ.H.Serv., through Dr. J.H. Hughes). — Texas: Edinburg, Hidalgo Co., 26° 20′ N. (S. and D. Mulaik); Uvalde Co., 29° 15′ N., on *Coragyps a. atratus*, Oct. 13, 1933 (A.W. Lindquist); Brownsville, Cameron Co., ♂ in a plane arriving from Mexico, June 8, 1947.

Mexico (recorded by Speiser, 1902; Ferris, 1928; de Buen, 1950): without precise locality, on vultures, probably *Coragyps a. atratus* (Esc.N.C.Biol.); San Blas, State Nayarit, on *Coragyps a. atratus* (G.F. Ferris); Iguala, State Guerrero, on vulture (Esc.-N.C.Biol.); Hato Frontera, State Chiapas, on *Sarcoramphus papa* (Esc.N.C.Biol.); Santa Rosa, Comitán, State Chiapas, on *Sarcoramphus papa* (Esc.N.C.Biol.); Tuxtepec, State Oaxaca (J. Camelo G.); Chitzen Itzá, State Yucatan, on *Coragyps a. atratus* (J. Bequaert); Xocempich, 10 miles from Chichen Itzá, State Yucatan, on *Coragyps a. atratus* (D.B. Legters); Mexico, D.F., on human (F. Biagi F.).

British Honduras: Belize, on *Sarcoramphus papa* (J.P. Johnson).

Guatemala: Concepcion del Mar, Dept. Escuintla, on *Coragyps a. atratus* (E.R. Blake); Guatemala City (Dr. Morales).

Nicaragua: Waunta-Hannover (W.H. Fluck).

Costa Rica (recorded by van der Wulp, 1903, as *O. vulturis*):

Río Sucio (Rogers. — ♀ and ♂ cotypes of *O. vulturis* at Brit. Mus.); Turrialba, on *Cathartes a. aura* (K.W. Cooper).

Panama (recorded by Darling, 1912, as *Olfersia* sp.; Dunn, 1934, as *vulturis* and *spinifera;* Cooper, 1942, 1944): Orchid I., Gatun Lake, C.Z., on *Coragyps a. atratus* (K.W. Cooper); Río Trinidad, on *Cathartes a. aura* (A. Busck); Camp Pital, Chiriqui Prov., on *Coragyps a. atratus* (L.H. Dunn); Ancon, C. Z., on *Coragyps a. atratus* (L.H. Dunn); Panama City, on *Coragyps a. atratus* (L.H. Dunn); Tapia, C. Z., on *Sarcoramphus papa* (J.P. Chapin); Camp La Vaca, Chiriqui Prov., on *Sarcoramphus papa* (L.H. Dunn); San-José, Pearl Is., on *Cathartes a. aura* and coming to light (J.P.E. Morrison); Porto-Bello, on *Cathartes a. aura* (A. Busck).

Colombia: Villavicencio, Int. del Meta, on *Coragyps atratus foetens* (E. Osorno-Salcedo; R.M. Gilmore); Meta District, on *Sarcoramphus papa* (B. Guevara); Victoria, Dept. Caldas, on *Cathartes aura jota* (E. Osorno-Salcedo).

Venezuela (recorded by Lutz and Nuñes-Továr, 1928; Falcoz, 1930, as *diomedeae;* Vogelsang, 1936, as *P. vulturis*): Puerto La Cruz, D.F., on *Coragyps atratus foetens* (E.G. Holt); Selvas de San Camilo, States Tachira and Barinas (P. Anduze); San Esteban, State Carabobo, on *Coragyps atratus foetens* (P. Anduze); southeastern Guarico, on *Vultur gryphus* (P. Anduze); Caura Valley.

Trinidad: Quare Dam, on *Sarcoramphus papa* (A.M. Adamson).

British Guiana (recorded by Bodkin, 1919): Issororo, on *Coragyps atratus foetens* (C.E. Bodkin); Georgetown, on *Cathartes aura ruficollis* (W. Beebe); Kartabo (W. Beebe); Kalacoon (W. Beebe).

French Guiana: without host or precise locality (H. Floch).

Brazil (recorded by Austen, 1903, as *spinifera;* Lutz, Neiva and da Costa Lima, 1915): Cayari I., Uassa Swamp, State Pará on *Sarcoramphus papa* (S.M. Klages); Manáos, State Amazonas, on *Coragyps atratus foetens* (J. Bequaert); Vista Alegre, Rio Branco, State Amazonas, on *Coragyps atratus foetens* (J. Bequaert); Pará; Rio de Janeiro, in Zoological Garden, on *Vultur gryphus* (Ad. Lutz); State Minas Gerais, on *Cathartes aura ruficollis* (Ad. Lutz); Maracajú, State Matto Grosso, on *Cathartes aura ruficollis* (R.M. Gilmore); Aguafria, State Matto Grosso, on *Coragyps atratus foetens* (G. Fairchild); São-José-dos-Campos, State São Paulo, 23° 10′ S., on *Coragyps atratus foetens* (H. de Souza Lopes);

Cana Brava, State Goyaz (J. Blaser); State Goyaz, on *Sarcoramphus papa* (A. Neiva); Joazeiro, State Piauhy, on *Cathartes aura ruficollis* (A. Neiva); Fazenda Sto Amaro, Volta Grande, State Minas Gerais, on *Cathartes aura ruficollis* (C. Lako); Floresta da Capela de S. Braz, Sta. Teresa, State Espirito Santo, on *Cathartes aura ruficollis* (C. Lako); Rio Tapajos, State Pará, on *Coragyps atratus foetens;* State São Paulo, on *Sarcoramphus papa;* Porto Alegre, State Minas Gerais (F.S. Pereira); Goiania, State Goyaz, on *Cathartes aura ruficollis* (E. Dente).

Bolivia: Province Sara (J. Steinbach).

Peru (recorded by Murphy, 1912; Schuurmans Stekhoven, 1952): Central Chincha I., on *Cathartes aura jota* (R.C. Murphy); Trujillo, on vulture (W. Weyrauch); Negritos (N.Y. State Mus.).

Chile (recorded by Macquart, 1847): without precise locality, ♀ type of *bisulcata.*

O. bisulcata is restricted to the New World, where it is essentially a tropical insect. The only two captures under natural conditions in the United States are from extreme southeastern Texas and they may have been accidental occurrences. The northmost record is from 29° 15′ N. and the southmost from 23° 10′ S.

Known hosts of *O. bisulcata* (verified individual records in parentheses). Falconiformes (44 and 3 unidentified vultures): *Cathartes a. aura* (4); *C. aura jota* (2); *C. aura ruficollis* (7); *C. urubutinga; Coragyps a. atratus* (10); *C. atratus foetens* (9); *Sarcoramphus papa* (10); *Vultur gryphus* (2).

Bionomics. To judge from the list of known hosts, *O. bisulcata* is a strictly specific parasite of vultures and condors (Family Cathartidae).[62] Although these birds are included in the Order Falconiformes, they are very distinct and perhaps not closely related to the other diurnal birds of prey. The fact that they possess a peculiar fly, of a genus not found normally on other Falconiformes, may have some significance in this connection. The fly seems to be about equally frequent on the three common American vultures: the turkey vulture (*Cathartes aura*), the black vulture (*Coragyps atratus*) and the king vulture (*Sarcoramphus papa*). The records from urubitinga (*Cathartes urubutinga*) and condor (*Vultur gryphus*) are as yet too few to decide whether or not these birds are true breeding or only accidental hosts.

The following note by C.B. Koford (1953, The California

[62] A published record from "sparrow hawk" (J. Bequaert 1933*a,* p. 570) should be discarded as unreliable.

Condor, p. 125) suggests that *Gymnogyps californianus* occasionally harbors either *O. bisulcata* or *Lynchia nigra:* "Twice I saw a flat-bodied fly, probably a hippoboscid, on the head of a nestling." If confirmed, this occurrence will add one of the two flies to the California list.

O. bisulcata is a common hippoboscid. In many localities it occurs on nearly every vulture examined and often in some numbers on one bird. Ferris (1928*a*), for instance, took 16 specimens in Mexico from one black vulture and estimated that the bird had harbored 30 to 40 flies. Dr. J.P. Chapin informs me that some 12 to 15 flies escaped from a freshly killed king vulture, in Panama, after the bird was brought indoors.

The newly deposited third larval instar, 5 mm. long when flattened and mounted on a slide, was described and figured by Ferris (1928*a*) as follows. "The posterior end is capped by a single plate, representing probably a fusion of the usual paired spiracles, this plate being pierced by a number of small, pore-like openings which communicate with tracheal trunks." The arrangement of the pores could not be determined. "The entire body, excepting only the stigmatic plate and a narrow transverse zone which extends entirely about the body near the cephalic end, is thickly beset with short spines. These are spines, not setae, there being no socket. They vary somewhat in size, being noticeably larger near the center of the body on both dorsal and ventral sides. In addition to these the derm is everywhere marked by small, subcircular, clear areas. The transverse zone which is free from spines marks the line along which the puparium splits at the time of emergence of the adult." Three puparia I have seen from Uvalde, Texas, obtained from adults on *Coragyps a. atratus*, agree with this description, except, of course, that the integument is completely hardened and black throughout. The stiff, prickly hairs are thin, pointed, straight (Fig. 93*G*), either somewhat slanting or erect on the puparium; on the intrauterine and newly-voided larva they lie flat, with the points directed forward. A careful examination has failed to disclose the anchor-shaped barbs at the tips of the hairs found in the other 4 species of *Olfersia* with known puparia. The puparium (Figs. 93*F–I*) is 4 to 4.5 mm. long, 3 mm. wide and 2.5 mm. thick, regularly and broadly ovoid seen from above, more elliptical in side view. The two polypneustic lobes are separated by a broad, shallow saddle; each lobe bears about 50 minute respiratory pores on irregular, fairly evenly spaced, low mounds, showing no distinct grouping; seen from behind the apical saddle is pro-

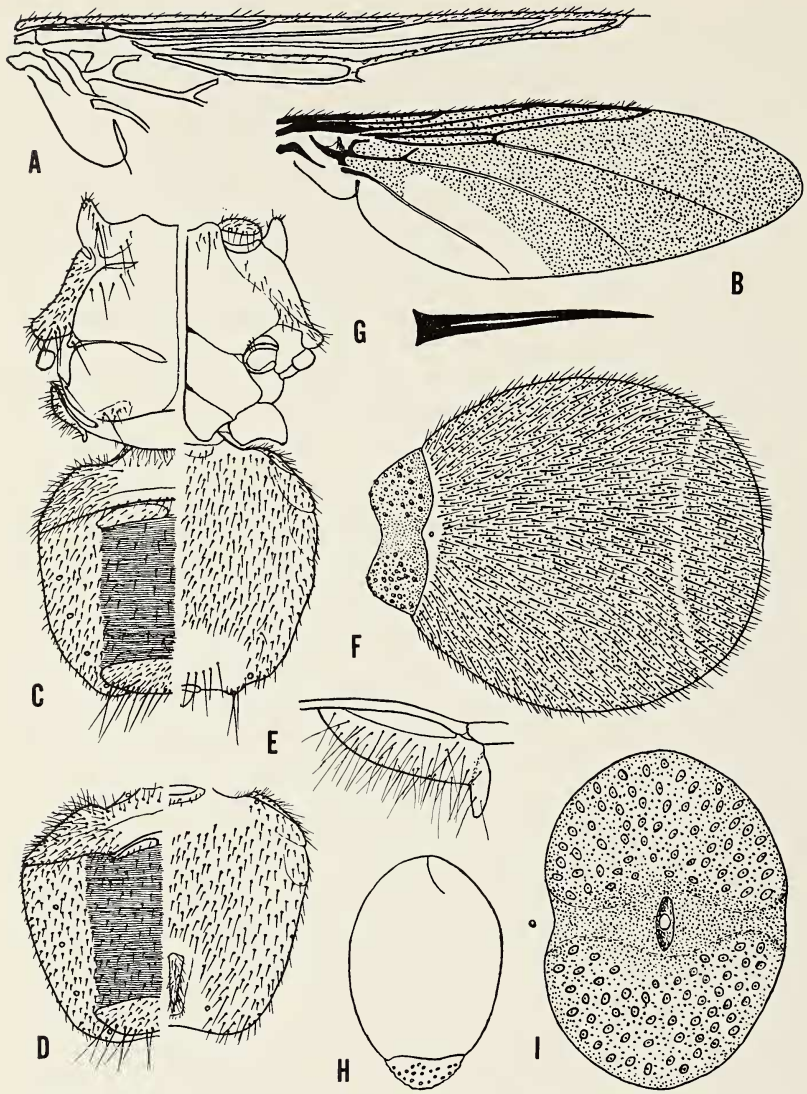

Fig. 93. *Olfersia bisulcata* Macquart. **A**, anterior part of wing, the microtrichia omitted, ♀, Panama City, on *Coragyps a. atratus;* **B**, wing of same; **C**, thorax and abdomen dorsally and ventrally of same; **D**, abdomen dorsally and ventrally, ♂, Tapia, C.Z., on *Sarcoramphus papa;* **E**, left metanotal pleurotergite of same; **F-I**, puparium from fly on *Coragyps a. atratus,* Uvalde: **F**, dorsal view; **G**, one of the pointed hairs; **H**, side view, hairs and punctures omitted; **I**, peripneustic lobes from behind.

vided with a narrow, transverse depression, with a small, raised knob at the bottom.

In Part I (p. 160) I mentioned a male infested with mites. The following additional cases of mite infestation have been noted since.

2. A ♀ from La Vaca, Chiriqui, on *Sarcoramphus papa*, carried a ♀ mite, without eggs, on the upper side of the palpi, near the base, close to the tip of the frons.

3. A ♀ from Victoria, Caldas, on *Cathartes aura jota*, carried two ♀ mites, without eggs: one at the tip of the abdomen, close to the anal opening; the other on the upper side of the right fore femur, near the tip.

In Part I (p. 141) I recorded also one case of infestation with fungi (Laboulbeniales) and I discussed (pp. 254 and 318) the host-parasite relations.

Affinities. *O. bisulcata, O. fumipennis* and *O. fossulata* are closely related and few reliable differential characters can be added to those given in the key. The frons in particular is very similar in all three; but the striolate median area of the interantennal part is more extensive in *bisulcata* (Fig. 86*B*) than in *fossulata*, though about as in *fumipennis*. In all 3 species this striolate area is depressed and separated by a strong, blunt, smooth ridge from the antennal pit on each side; the depression extends as deep, broad grooves over the diverging, bluntly pointed sides of the frons. There is no significant difference in the venation or in the extent of the microtrichia on the membrane of the wing; but in *bisulcata* the 2nd basal cell is relatively shorter than in the others, being about half the length of the 1st basal cell; in all 3 species the 1st longitudinal vein ends far apicad of the anterior cross-vein and the posterior basal cross-vein is very oblique. In *bisulcata* the setae on the 3rd longitudinal vein are very small and easily overlooked; in some specimens they are restricted apparently to the apical section of the vein, but in others they may be traced also basad of the anterior cross-vein. The 3 species also agree in the chaetotaxy of the body: the orbital bristles are many and in two irregular rows; there is only 1 vertical bristle on each side near the postvertex; and a notopleural bristle is always present on the lobe between anepisternum and mesoscutum. The two soft lobes on the rim of the anal, apical or ventral sclerite in the ♀ are broad, short and more or less fused, sometimes almost completely so (as in Fig. 90*F*, *lo*, for *O. fumipennis*). The metanotal pleurotergite is shaped almost exactly alike in all 3 species.

Original description of *O. bisulcata* (French text translated): "Fusca. Facie fossulata. Thorace bisulcata. Pedibus rufis. Alis fuscis. Length 3 [French] lines [=6.76 mm.]. Palpi extending slightly beyond the antennae. Face brown, with a small pit near the suture. Frons with a light green sheen. Thorax with a violaceous sheen. The two longitudinal furrows a short distance apart. Femora pale fulvous, somewhat greenish." Some years ago Mr. J.E. Collin examined the female type at my request, giving me information enabling me to synonymize with it van der Wulp's *O. vulturis*. He also recognized that the specimen which was labelled "*mexicana*" in the Bigot Coll., was cospecific with *bisulcata*. My own study of both these flies in 1951 confirmed Mr. Collin's conclusions. The wing of both is about 8 mm. long. Speiser (1902) had previously studied the same two specimens, which he placed as distinct species in *Pseudolfersia*. The name labels of both specimens appear to be in Macquart's handwriting. Nevertheless the fly labelled "*mexicana*" in the Bigot Coll. is not the type of that species, as it does not agree with the original description. The true type, in the Paris Museum, is a female of *Lynchia nigra* (Perty), as shown in my discussion of that species.

Original description of *O. vulturis*: "♀ Dark brown; front [interocular face] and eyes shining; first vein ending beyond the small [anterior] cross-vein; 3rd vein reaching costa at ⅔ its length. Length 6.5 mm. Nearly unicolorous dark brown; the eyes reddish-brown and shining; front [interocular face] somewhat shining, with an impressed line on both sides along the eyes and several impressions in the middle. Shoulders coniform, exserted; transverse suture of the thorax very distinct. Legs robust; femora thick, the hind pair longer than the others; claws black. Wings with a brown tinge; first vein reaching the costa distinctly beyond the small [anterior] cross-vein, which stands before the middle of the wing's length; second section of costa (from the humeral cross-vein to the end of the auxiliary vein [subcosta]) nearly as long as the 3rd section (from the end of the auxiliary vein to the end of the 1st vein); the two following sections (from the 1st to the 2nd vein and from the 2nd to the 3rd vein) shorter and of nearly equal length; the 3rd vein ending on the costa at ⅔ of its length; 2nd basal cell incomplete and retracted towards the base of the wing. Two specimens, one of which is labelled 'parasite of vulture.' This species seems to be allied to *Ornithomyia villadae* Dugès, which also belongs to the genus *Olfersia;* but its head is without metallic greenish tinge, and the legs are of the same colour as the body, whilst in *villadae* the two posterior pairs are black." I have examined the two types (♀ ♂) of *vulturis* at the British Museum in 1951. They agree in every detail with the common fly of American vultures for which I use Macquart's earlier name *bisulcata*. According to Dr. G.B. Fairchild (*in litt.*, Nov., 1953), the wing of the male is 7.8 mm. long and that of the female 8.7 mm.

Olfersia fossulata Macquart

Figs. 86*C–D*, 94*A–F* and 95

Olfersia fossulata Macquart, 1843, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1842), p. 434 [1843, Dipt. Exot., 2, pt. 3, p. 277] (no sex; no host. Brazil. Type ♀ at Paris Mus.). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 189 (copy of description). Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (in part: specimen from Galapagos: Daphne Major I., on *Pelecanus occidentalis californicus*). Curran, 1932, Nyt Mag. Naturvidenskab., **71**, p. 366. J. Bequaert, 1933, Psyche, **40**, pp. 102 and 105; 1933, Proc. California Ac. Sci., (4), **12**, p. 132; 1933, Rev. Chilena Hist. Nat., **37**, p. 164. Thompson, 1938, Ent. Mo. Mag., **74**, p. 43. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 320 and 321; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1941, Occ. Papers Bernice P.

Bishop Mus., Honolulu, **16**, No. 11, pp. 271 and 272. Wolcott, 1941, Jl. Agric. Univ. Puerto Rico, **25**, pt. 2, p. 121 (Puerto Rico: Desecheo I., on *Sula l. leucogaster*). Stuardo, 1946, Catálogo Dípteros Chile, p. 187. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 155 (St. Croix). Wolcott, 1951, *Op. cit.*, **32**, (for 1948), pt. 3, p. 530. Donoso Barros, 1949, Rev. Méd. Chile, **77**, pt. 6, p. 404 (Chile: Isla del Alacran, Arica, biting Man). J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, (1950), p. 9.

Pseudolfersia fossulata Coquillett, 1901, Proc. Washington (D.C.) Ac. Sci., **31**, p. 379 (Galapagos: Wenman I.).

Olfersia forsulata "Macquart" Thompson, 1936, Ann. Mag. Nat. Hist., (10), **18**, p. 316 (error for *O. fossulata*).

Pseudolfersia maculata Murphy, 1921, Comp. Administr. Guano, **12a** Mem. del Directorio, Lima, p. 112 (Peru: on the Guano Islands, off the coast: Chincha, Mazorca, Pescadores, and Lobos de Afuera; on *Phalacrocorax bougainvillii, Sula variegata, Pelecanus occidentalis thagus* and *Larus belcheri*); 1925, Bird Islands of Peru, p. 250. Not of Coquillett, 1899.

Olfersia diomedeae Falcoz, 1930, Encyclop. Entom., Sér. B, Diptera, **5**, (for 1929), p. 46 (in part: only specimen from Santiago de Chile). Not of Coquillett, 1901.

Distribution and Specimens Examined. Panama: Canal Zone, without precise locality (C. Evelyn Cheesman).

Cocos I.: Wafer Bay (W.H. Osgood and D. Lambert).

Antilles. Puerto Rico (recorded by Wolcott, 1941, 1951): Desecheo I., on *Sula l. leucogaster* (S.T. Danforth). — St. Croix (recorded by Beatty, 1947): specimens seen (H.A. Beatty).

Brazil (recorded by Macquart, 1843): type ♀, without precise locality, at Paris Mus.

Ecuador: Guayaquil (C.L. Fagan).

Peru (recorded by Murphy, 1921): On board ship, off the coast, on *Sula variegata* (E.P. Reed); Chincha Is., without host (J. Ortiz de la Puente), on *Phalacrocorax bougainvillii* (G.S. Myers), on *Larosterna inca* (Templeton Crocker Exped., 1935) and on *Sula variegata* (Ac.Sci.Calif.); Lima, on *Tyto alba contempta* (W. Weyrauch); Cruz de Husco near Lima, on *Pelecanus occidentalis thagus* (R.C. Shannon); Lobos de Afuera, Chincha Is., from *Pelecanus occidentalis thagus* rookery (R.E. Coker); Mazorca I., Chincha Is., on *Larus belcheri* (R.C. Murphy); Pescadores, Chincha Is. (R.C. Murphy); Chincha Is., on *Phalacrocorax bougainvillii* (Martinez); Ancon, without host (E.S. Ross), on *Larosterna inca* (C.H.T. Townsend), and on *Phalacrocorax gaimardi* (R.H. Beck); San Lorenzo I. near Callao, on nesting sites of *Phalacrocorax bougainvillii* (W. Weyrauch); Pachacamac near Lima, on *Phalacrocorax bougainvillii* (W. Weyrauch); Chala, on *Larus belcheri* (W. Weyrauch); Río Lurin, on *Pelecanus occidentalis thagus* (W. Weyrauch).

Galapagos (recorded by Coquillett, 1901; Johnson, 1924).

Chile (recorded by Falcoz, 1930; Donoso Barros, 1949): Tofo, on *Pelecanus occidentalis thagus* (T. Hallinan); Lluta (Rosario); Arica (G. Kuschel; R. Donoso Barros); [Santiago (C.E. Porter. — Specimen at Paris Mus. recorded by Falcoz as *diomedeae;* a very doubtful record); Valparaiso (E.P. Reed; a very doubtful record)].

O. fossulata is mainly a Neotropical insect, ranging from Panama and Puerto Rico to northern Chile. The records from central Chile need confirmation. It has never been taken on a host in the United States; but I have seen a specimen found February 19, 1949, on a plane arriving at New Orleans from Balboa (according to Mr. J.H. Hughes, *in litt.*). There are few reliable records from the Old World, *viz.*, from the Philippine Is. (W. Schulze. — Specimen at U.S.Nat.Mus.) and from Wetter I., Indonesia (specimen at Amsterdam Zool. Mus.), unfortunately without indication of host.

Known American Hosts of *O. fossulata* (verified individual records in parentheses). Pelecaniformes (12): *Pelecanus occidentalis californicus; P. occidentalis thagus* (4); *Phalacrocorax bougainvillii* (4); *P. gaimardi* (1); *Sula l. leucogaster* (1); *S. variegata* (2). Charadriiformes (4): *Larosterna inca* (2); *Larus belcheri* (2). Strigiformes (1): *Tyto alba contempta* (1).

Bionomics. The small number of verified host records is misleading, as no doubt each lot consisted in most cases of flies pooled from several individual birds or caught in the open at nesting sites of the hosts. Actually *O. fossulata* is a common and abundant parasite of marine fish-eating birds. The several Pelecaniformes and Charadriiformes listed above are its usual and presumably only breeding hosts. They nest mostly in close proximity and often in enormous numbers in rookeries. Foremost among such nesting sites are the Guano Islands off the west coast of South America. Here the flies sometimes swarm over the bare ground, rocks and low vegeation of the rookeries, as well as over the young birds, so that it is difficult to decide whether any of the several species of birds nesting together in one place are preferred or more suitable breeding hosts. R.C. Murphy (1924, *National Geographic Magazine,* 46, p. 294) published a photograph of a guanay, *Phalacrocorax bougainvillii,* carrying several *O. fossulata* on the head. This picture is here reproduced by permission (Fig. 95). The following passage from the same author's "*Bird Islands of Peru*" (1925) also refers to this fly: "The feather flies are enor-

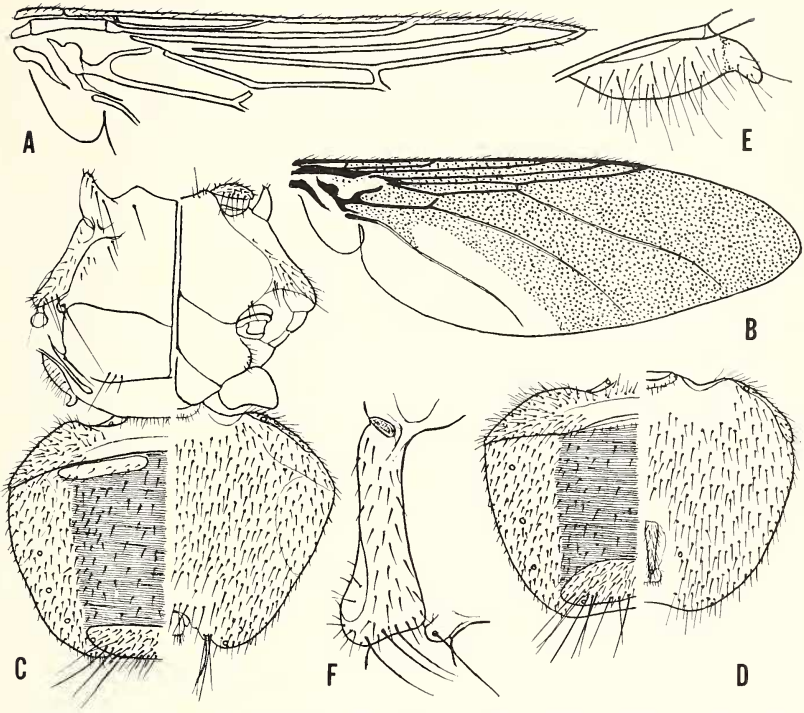

Fig. 94. *Olfersia fossulata* Macquart. **A**, anterior part of wing, the microtrichia omitted, ♀, Ancon, Peru, on *Phalacrocorax gaimardi;* **B**, wing of same; **C**, thorax and abdomen dorsally and ventrally, ♀, coast of Peru, on *Sula variegata;* **D**, abdomen dorsally and ventrally, ♂, Chinchas Is., on *Phalacrocorax gaimardi;* **E**, left metanotal pleurotergite, ♂, Lobos de Afuera, on *Pelecanus occidentalis thagus;* **F**, dorsal aspect of left anepisternum of same.

mously abundant; sometimes a dozen together can be seen sidling about the plumage of a nestling guano bird, and slipping in and out between the feathers in an uncanny way. On one December afternoon an inconceivable number covered the soil on the leeward slope of Mazorca Island. Practically no breeding birds occupied this side of the island, but there were colonies of both guanayes and piqueros on the windward exposure. The flies were so thick that hundreds dotted each square yard of ground. When I laid down my gun, it was immediately covered with the shiny, jerky creatures.'' The one record from an owl (*Tyto*) should be regarded as an accidental stray. The host relations were also discussed in Part I (p. 323).

Thus far I reported only one case of infestation with mites for this species (Pt. I, p. 160). Several more cases have now been observed. In fact mites are by no means rare on *O. fossulata;* but the infestation seems to consist usually of single mites, without egg clusters, a peculiarity for which I can offer no explanation at present.

2. Of a total of 22 flies from the Chincha Is., on *Phalacrocorax bougainvillii*, 5 carried mites, in 3 cases single ♀ without eggs and in the other 2, mites with egg clusters. In 2 ♂ and 2 ♀ flies the mites were fixed to the abdomen, either at the tip, or dorsally, or ventrally. In one a mite cluster was attached to the under side of the head at the base of a palp.

3. A ♂ from San Lorenzo I., taken in a rookery of *Phalacrocorax bougainvillii*, carried several mite clusters dorsally in the gap between head and thorax.

4. A ♂ from Lobos de Afuera, taken in a rookery of *Pelecanus occidentalis thagus,* carried a single mite without eggs on the abdomen ventrally.

5. A ♂ from Mazorca I., on *Larus belcheri,* carried 3 ♀ mites without eggs, 2 on the left side of the thorax at the base of the wing and 1 ventrally at the tip of the thorax behind the left hind coxa.

6. A ♀ from Arica, host unknown, carried one mite without eggs on the dorsum of the abdomen.

The puparium is as yet unknown.

Donoso Barros (1949) reported the interesting case of a workman on Isla del Alacran, a guano island near Arica, Chile, who complained of intermittent itching at reddish blotches of the skin, followed later by papules. These symptoms resulted from the bites of *Olfersia fossulata*, some of which were found in the man's clothing. I have seen some of the specimens of this case.

Affinities. These have been discussed at some length for *O. fumipennis* and *O. bisulcata*, the two close relatives of *O. fossulata.* While there is no reliable difference in the 3 species in the shape of the combined lunula and interantennal frons, in *O. fossulata* (Fig. 86*D*) the striolate median area is markedly narrower in the upper part than in the other two. In the wing, the 2nd basal cell is over half the length of the 1st; and setulae occur on the 3rd longitudinal vein apicad only of the anterior cross-vein and often on the apical half only of this terminal section.

Original description of *O. fossulata* (French text translated): "Nigra virescens, Facie fossulata. Pedibus alisque fuscis. Length

Fig. 95. *Olfersia fossulata* Macquart, on *Phalacrocorax bougainvillii*, Chinchas Is. Photograph by Dr. Robert C. Murphy; reproduced by permission.

$2\frac{3}{4}$ French lines [= 6.2 mm.]. Proboscis not protruding. Face black, shiny; a small cavity near the suture separating the frons; a small spot of whitish pilosity at the insertion of the antennae. Frons shiny black, with greenish sheen; the sides dull black. Head brownish beneath. Thorax with greenish sheen; breast brownish. Abdomen brown. Legs black above, greenish fulvous beneath. Wings blackish; inner margin [hind margin] pale yellow." The type, recently (1951) seen at the Paris Museum, is a female (so far as could be ascertained), showing all the characters here attributed to the species.

Olfersia sordida Bigot

Figs. 14*E*, 84*D*, 85*D* and 96*A–H*

Olfersia sordida Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 239 (no sex; no host. Guatemala. Type ♂ from Bigot Coll., now in J.E. Collin Coll.). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 192 and 194 (copy of description). J. Bequaert, 1933, Psyche, **40**, pp. 101 and 103; 1940, Rev. Acad. Colombiana Ciene. Ex. Fis. Nat., **3**, No. 12, p. 416; 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 319 and 321; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **16**, No. 11, p. 271, figs. 2*a–c;* 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 81. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 155 (St. Croix).

Pseudolfersia sordida Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 164

(type). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Pseudolfersia spinifera Johnson, 1908, Psyche, **15**, p. 80 (in part: specimens on cormorant, Bahamas); 1922, *Op. cit.*, **29**, p. 85 (same Bahamas specimens). Not of Leach, 1817.

Olfersia fossulata Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (in part: specimens on cormorant, Bahamas). Not of Macquart, 1843.

Distribution and Specimens Examined. United States. Florida: Merritt I., Brevard Co., on young *Pelecanus occidentalis carolinensis*, September 19 (D.J. Nicholson); Pine I., Punta Gorda, Charlotte Co., on *Pelecanus occidentalis carolinensis* (R. Archbold). — Louisiana: Pass-a-L'Outre, Plaquemines Parish, on *Pelecanus occidentalis carolinensis* (C.S. Hathaway). — Received from F.H. Wilson). — Oregon: Camp Harney, Harney Co. (C. Berchin). — Texas: Galveston, Galveston Co., on *Pelecanus occidentalis carolinensis* (R.W. Strandtmann). — Utah: Antilope I., Davis Co. (I. Berryman). — Also Florida: Gainesville, Alachua Co., 6 ♀, 3 ♂, on *Strix varia georgica* (O.E. Baynard).

Mexico: Sta. Lucrecia, State Vera Cruz (E.G. Smyth); San Blas, State Nayarit, on *Pelecanus occidentalis californicus* (G.F. Ferris).

Guatemala (recorded by Bigot, 1885): without precise locality (J. Deby).

Panama: San José, Pearl Ids., Gulf of Panama, on *Leucophoyx t. thula* (R.C. Murphy); Barro Colorado, C.Z., on *Pelecanus occidentalis californicus* and *Phalacrocorax olivaceus* (J. Van Tyne); Panama City, on *Pelecanus occidentalis californicus* (L.H. Dunn); near Taboguilla and Otoque Is., Panama Bay, on *Pelecanus occidentalis californicus* (A.D. Foster, through L.E. Rozeboom); Paitilla Point, Panama City, on rocks where cormorants were nesting.

Antilles. Bahamas (recorded by Johnson, 1908, 1922, 1924): Great Salt Cay, on *Phalacrocorax auritus floridanus* (T. Barbour, G.M. Allen and O. Bryant). — Cuba: near Cape San Antonio, Prov. Pinar del Río, on *Pelecanus o. occidentalis* (D.D. Davis). — Isle of Pines: Hanal Bay, Los Indios, on *Phalacrocorax auritus floridanus* (G. Link). — Jamaica: without precise locality (Shoemaker). — Hispaniola: Beata I., on *Pelecanus* sp. — St. Thomas: Drift Bay, Water I. (Shoemaker). — St. Croix (recorded by Beatty, 1947): Christiansted (H.A. Beatty).

Venezuela: Puerto La Cruz, D.F., Caracas, on *Pelecanus o. occidentalis* (E.G. Holt).

Trinidad: North Manzanilla (E. McC. Callan); without precise locality, on *Pelecanus o. occidentalis* (F.W. Urich).

Galapagos: Indefatigable I. (L. Evelyn Cheesman); James I. (L. Evelyn Cheesman).

Brazil: Piquiri, State Matto Grosso (Inst. Osw. Cruz).

O. sordida is mainly a Neotropical insect, occurring on both the Pacific and the Atlantic coasts. It is very rare and presumably only accidental north of 30° N. It is not known south of the Tropic of Capricorn nor from the Old World.

Known Hosts of *O. sordida* (verified individual records in parentheses). Pelecaniformes (14 and 1 unidentified pelican): *Pelecanus o. occidentalis* (3); *P. occidentalis californicus* (4); *P. occidentalis carolinensis* (4); *Phalacrocorax auritus floridanus* (2); *P. olivaceus* (1). Ciconiiformes (1): *Leucophoyx t. thula* (1). Strigiformes (1): *Strix varia georgica* (1).

Bionomics. Although *O. sordida* is probably by no means rare, there are not many individual host records. The majority of these are from pelicans, which are definitely its true breeding hosts. Cormorants possibly also serve as such, but the records are too few to be conclusive. The single record from a snowy egret I regard as an accidental stray. The puparium is unknown. The host relations are briefly discussed in Part I (p. 320). The unusual occurrence of several flies on a Florida barred owl may perhaps be explained by the similar nesting habits of this owl and the Florida brown pelican. Both often nest in low trees in similar situations; occasionally the owl even uses an abandoned tree nest of some other large bird.

I have observed 2 infestations with mites on *O. sordida:*

1. A ♀ from Galveston, Texas, on *Pelecanus occidentalis carolinensis*, carried a ♀ mite with an egg cluster on the under side of the head, fixed to the middle of the gula at the base of the proboscis.

2. A ♂ from Jamaica, on *Pelecanus o. occidentalis*, carried a mite with an egg cluster at the tip of the abdomen.

O. sordida also appears to be particularly prone to infestation with Laboulbeniales of the genus *Trenomyces*, since in the relatively limited material examined 12 flies were infested with these fungi:

a. The ♀ from Galveston, on *Pelecanus occidentalis carolinensis*, mentioned above as infested with mites, also carried several small patches of fungi on the dorsum of the abdomen.

b. A ♀ from Pass-a-L'Outre, Louisiana, on *Pelecanus occi-*

dentalis carolinensis, carried small patches of fungi on the dorsum of the abdomen.

c. A ♀ from Great Salt Cay, Bahamas, on *Phalacrocorax auritus floridanus*, carried small patches of fungi on the hind dorsal sclerite of the abdomen.

d. All 6 ♀ and 3 ♂ from Gainesville, Florida, on *Strix varia georgica*, carried patches of fungi on the dorsum of the abdomen.

Affinities. Although *O. sordida* is a true *Olfersia* in all essential features, it is isolated in the genus owing to several unusual characters. The peculiar structure of the basal sclerites of the abdomen, the bulging 1st basal cell, the setulae on the 4th longitudinal vein and the absence of a notopleural bristle on the lobe between anepisternum and mesoscutum are unique features. The bulge of the 1st basal cell recalls that of the tsetse-flies (Glossinidae), where it is, however, much more pronounced and a family characteristic. The shape of the combined lunula and interantennal frons (Fig. 84*D*) is also distinctive, with the apical margin divided by a deep median notch into two broadly rounded sides; the median striolate area occupies most of the surface of the interantennal frons, but is only slightly depressed and not grooved apicad. The following additional characters may also be mentioned. First longitudinal vein reaching costa opposite or slightly basad of anterior cross-vein; 2nd longitudinal vein ending much nearer tip of 3rd than of 1st; 3rd and 4th longitudinal veins completely fused over a short stretch at base of 1st basal cell; basal section of 5th longitudinal vein not or only slightly shorter than 2nd section of 4th; anterior basal cross-vein very oblique; setulae on the longitudinal veins usually better developed than in the congeners (Figs. 96*A–B*). In Fig. 96*B* the area of the postaxillary cell and alula covered with microtrichia on the under surface only of the membrane is indicated by more spaced stippling. The chaetotaxy is more developed than in the other species of the genus, particularly on the inner orbits (Fig. 85*D*) and dorsally on the thorax, where the bristles are placed in conspicuous patches of dull, grayish, densely matted, microscopic hairs; a streak of similar, dull hairs along the unusually deep transverse mesonotal suture; minute, dull hairs also cover the basal sclerite of abdomen. Usually 2 (rarely 1) vertical bristles at each side of postvertex. The median striolate area of the abdomen dorsally (Figs. 96*C* and *E*) is less extensive than in the congeners. The metanotal pleurotergite is distinctive (Fig. 96*D*), the basal attached portion being low and rather flattened, while the protruding free "thumb" is

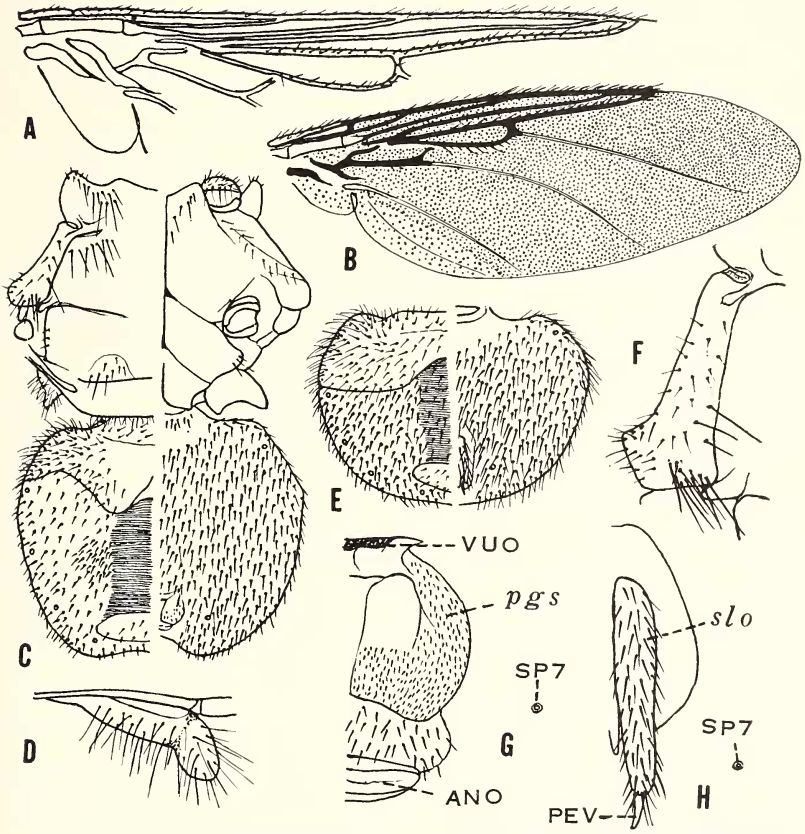

Fig. 96. *Olfersia sordida* Bigot. **A**, **B** and **E**, Trinidad, on *Pelecanus o. occidentalis;* **C**, **D** and **F**, Great Salt Cay, on *Phalacrocorax auritus floridanus;* **G** and **H**, Panama City, on *Pelecanus o. occidentalis:* **A**, anterior part of wing, the microtrichia omitted, ♂; **B**, wing of ♂; **C**, thorax and abdomen dorsally and ventrally, ♀; **D**, left metanotal pleurotergite, ♀; **E**, abdomen dorsally and ventrally, ♂; **F**, dorsal aspect of left anepisternum, ♀; **G**, one side of ventral ano-genital area, ♀: *ANO,* anal opening; *pgs,* paragenital sclerite; *SP7,* 7th abdominal spiracle; *VUO,* vulvar opening; **H**, one side of ♂ terminalia, in folded condition: *PEV,* penis valve; *slo,* setigerous lobe; *SP7,* 7th abdominal spiracle.

larger and thicker than usual. In the ♀ the venter of the abdomen bears apically, between the saucer-shaped anal sclerite and the vulvar opening, a much enlarged paragenital sclerite (Fig. 96*G*, *pgs*), with a median pair of raised, strongly sclerotized, bare and smooth areas; but the rim of the anal sclerite seems to lack the usual pair of free or fused lobes. In the ♂ the setigerous lobes are decidedly more slender throughout than in the other species of *Olfersia* (Fig. 96*H*, *slo*).

Original description of *O. sordida* (French text translated): "Long. 5 mm. Antennis fuscanis, flavo pallido villosis; toto corpore nigro fusco, thorace nitido; femoribus basi lividis; alis fuscanis, venis, costali, longitudinalibus 1-4is, omnino, 5a et 6a, usque ad venas transversas nigras, nigro tinctis. — Entirely blackish-brown, except for the shiny thorax; antennae brown, with yellowish hairs; a rounded, shiny disk placed above the epistome [frons] bearing a median deep pit, the vertex entirely covered by a broad trapezoidal shiny plate; eyes blackish. Scutellum without setae. Legs blackish, femora livid-yellow at the base, with some short, russet setae; wings smoky; the costa, 1st, 2nd, 3rd, and 4th longitudinals, and the two cross-veins entirely black, the 5th and 6th longitudinals of this color only as far as the cross-veins. First longitudinal fused to the costa opposite the 1st [anterior basal] cross-vein; 2nd longitudinal fused to the costa far from the 1st longitudinal; the two basal cells very unequal." Some years ago, Mr. J.E. Collin examined the male type at my request and compared it with a male from Jamaica now at the U.S. Nat. Mus. He found that it has all the characters mentioned for the species in my key. He stated in particular that "the first tergal plate has an open Λ-shaped excision in the hind margin," a character not found in any other species of *Olfersia*. All this I was able to confirm recently (1951) by a personal study of the type. Speiser (1902) also saw it, but some of his statements are misleading, particularly his description of the 2nd basal cell ("hintere Basalzelle").

Olfersia coriacea van der Wulp
Figs. 7*F*, 84*B* and 97*A–I*

Olfersia coriacea van der Wulp, 1903, Biol. Centr.-Amer. Diptera, **2**, p. 430; Pl. 13, figs. 2–2*a* (doubtfully as ♀, really ♂; no host. In part: Guatemala: Mirandilla, figured ♂ only, selected as the true type [holotype] by Austen, 1903. [The ♂ cotype from Presidio, Mexico, is *Olfersia propinqua* Walker = *Lynchia albipennis*]. Types in Brit. Mus.). J. Bequaert, 1932, Psyche, **38**, (for 1931), pt. 4, p. 187; 1933, *Op. cit.*, **40**, pt. 3, pp. 103 and 105; 1933, Carnegie Inst., Washington, Publ. No. **431**, p. 569; 1938, *Op. cit.*, Publ. No. **499**, p. 227; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 82. Fuentes Novella, 1944, Rev. Agric., Dir. Gen. Agric., Guatemala, (2), **1**, No. 1, pp. 13–14 (Guatemala). Beltrán, 1944, Scientific Monthly, **59**, p. 116 (Mexico: Yucatan). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Biagi, 1953, Leishmaniasis Tegumentaria Mexicana, p. 62 (Mexico: Campeche).

Pseudolfersia coriacea Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 265 (types; figured ♂ from Mirandilla, Guatemala, selected as holotype. Mexico: Orizaba, ♀. Brazil: Rio Tapajos, ♀). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Pseudolfersia meleagridis Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 179; Pl. 27, fig. 3 (no sex. Brazil: interior of State Pernambuco, on domestic *Meleagris g. gallopavo;* São-Luis-do-Maranhão, State Maranhão, on Man; State Minas Gerais or Espirito Santo, on *Tinamus solitarius;* cotypes at Inst.Osw.Cruz, Manguinhos near Rio de Janeiro; 1 ♂ cotype at U.S.N.M.). Lutz and Penna, 1918, *Op. cit.*, **10**, p. 85 (Brazil: Socorro, State Pernambuco, on domestic *Meleagris gallopavo*). Neveu-Lemaire, 1938, Traité Entomologie Médicale Vétérinaire, p. 983.

O. coriacea was also figured, without name, from a Yucatecan specimen by E. Farfán y López (1922, p. 13; dorsal and ventral view).

Olfersia mexicana Macquart (1843) was not based on *O. coriacea*, as I suspected at one time. What I regard as the true type of *mexicana*, at the Paris Museum, agrees with *Lynchia nigra* (Perty), as shown in Part II, pp. 325–326.

Distribution and Specimens Examined. Mexico (recorded by Austen, 1903; Farfán y López, 1922; Beltrán, 1944; Biagi, 1953): Orizaba, State Vera Cruz (Brit.Mus.); Volcano Colima, State Colima (Joh. Laue); Oaxaca, State Oaxaca, several flies taken on Man (Mrs. Ruth Oberg); Hato Frontera, State Chiapas, on *Penelope p. purpurascens* (Esc.N.Biol.Mex.); Matamoros, State Campeche, on *Ortalis vetula pallidiventris* (Esc.N.Biol.Mex.); El Tormento, 8 Kilom. W. of Escárcega, State Campeche, 1 ♀ on *Ortalis vetula pallidiventris*, Dec. (Julio Sosa); Kilom. 38 of Pital-Matamoros road, 9 Kilom. W. of Escárcega, State Campeche, 4 ♀ on *Agriocharis ocellata,* April 2 (Concepción Hernandez); on Pital-Matamoros road, 3 Kilom. W. of Escárcega, State Campeche, 1 ♂ on Man, but not biting, April 24 (Manuel J. Jas); 30 Kilom. N. of Candeleria, State Campeche, 1 ♂ on Man, but not biting, May (Oscar Silva); 16 Kilom. S.W. of Escárcega, State Campeche, 1 ♂ on Man, but not biting, March 18 (Angel Taje); [most of the flies from Campeche were seen through the kindness of Mrs. Ana María de Buen de Biagi]; Colonía Santa María, near Puerto Morelos, State Quintana Roo (G.C. Shattuck); Chetumal, State Quintana Roo (R.A. Paynter, Jr.); 24 Kilom. N.W. of Xtocomo, State Quintana Roo (R.A. Paynter, Jr.); State Quintana Roo (Herrera, 1919).

British Honduras: Gallon Jug, ♀ on *Agriocharis ocellata* (S.M. Russell).

Guatemala (recorded by van der Wulp, 1903; Fuentes Novella, 1944): Yaloche, Dept. Peten; Peten (O. Ricketson, Jr.); Uaxactun, Dept. Peten, on *Crax r. rubra* (J. Van Tyne); Mirandilla, about 15 miles N.W. of Escuintla, 1700 ft. (G.C. Champion. — Lectotype ♂ of *coriacea* at Brit.Mus.).

Panama: Juan Diaz (T. Hallinan); Upper Chagres River, on *Agriocharis ocellata* (H.L. Clark).

Colombia: San-Juan-de-Arama, Int. del Meta, on *Crax nigra* (E. Osorno); La Cueva, Sa. Marta, Dept. Magdalena, on *Crax a. alberti* (M.A. Carriker).

Venezuela: Yagua (H.A. Beatty).

British Guiana: Kartabo, on *Crax nigra* (W. Beebe); source of Essequibo River (J. Ogilvie); Upper New River, a tributary of the Courentyne River (E.R. Blake) and on *Crax nigra* (J.G. Myers).

Dutch Guiana: left bank of Upper Coppename River, on *Crax nigra* (D.C. Geijskes).

Brazil (recorded by Austen, 1903; Lutz, Neiva and da Costa Lima, 1915; Lutz and Penna, 1918): Rio Tapajos (Brit.Mus.); Pernambuco, on domestic turkey, *Meleagris g. gallopavo* (Ad. Lutz. — ♂ cotype of *meleagridis*, at U.S.Nat.Mus.); 1 ♂ caught in house (R.C. Shannon); Maracajú, State Matto Grosso, on *Crax* sp. [? *fasciolata*] (R.M. Gilmore); Descalvados, Rio Paraguay, State Matto Grosso, on *Crax fasciolata* (J.A.G. Rehn); Parahyba (C. Moreira); Ceará-Mirim, State Rio Grande do Norte, on domestic turkey, *Meleagris g. gallopavo* (D.C. Alves); State Goyaz, on *Crax fasciolata;* Coxim, State Matto Grosso, on *Mesembrinibis cayennensis* (J. Lima).

Bolivia: Río Colorado, on *Penelope* sp. (W.M. Mann).

Peru: Pucallpa and Aguaytia, Tingo María (E.J. Hambleton).

O. coriacea is a strictly Neotropical fly, known on the American continent from southern Mexico (19° N.) to Bolivia and Matto Grosso (22° S.).

Known Hosts of *O. coriacea* (verified individual records in parentheses). Tinamiformes: *Tinamus solitarius.* Ciconiiformes (1): *Mesembrinibis cayennensis* (1). Galliformes (18): *Agriocharis ocellata* (3); *Crax* sp. (1); *Crax a. alberti* (1); *C. fasciolata* (2); *C. nigra* (4); *C. r. rubra* (1); *Meleagris g. gallopavo* (2, in domestication); *Ortalis vetula pallidiventris* (2); *Penelope* sp. (1); *P. p. purpurascens* (1).

Bionomics. Although precise information, with specific identification of hosts, is as yet limited, it shows conclusively that *O. coriacea* uses only Galliformes of the families Cracidae and Phasianidae as true breeding hosts. As some of these birds are large and favorite game, the fly is one of the few hippoboscids known to laymen, particularly as it is prone to fly on people. It has been taken occasionally on domestic turkey in Brazil, where turkeys

do not now occur in the wild state; but there is no record thus far of its being found on wild turkeys in Mexico. The single records from tinamou and carauna in Brazil are clearly based on accidental strays, if at all trustworthy.

Straying of *O. coriacea* to Man was noted by Lutz, Neiva and da Costa Lima (1915) in Brazil, and has been observed often in Central America. It is frequently claimed to bite people. Possibly it may do so at times; but I have been unable to trace a fully reliable case of a fly actually sucking blood on a human. Mrs. Ana María de Buen de Biagi, who had much opportunity of observing this fly in nature, informs me (*in litt.*, 1954) that of the several specimens which she saw alight on people, none ever attempted to bite. Entomophobia is so prevalent among laymen, that I suspect that in most cases of so-called "bite" the fly was merely irritating by scratching the skin with its sharp claws. The matter is of some practical importance in view of the opinion, widely held in Yucatan and northern Guatemala, that the "mosca chiclero" (*O. coriacea*) is the transmitter to humans of cutaneous leishmaniasis ("bay sore" or "ulcera de los chicleros"). I discussed this problem in Part I (pp. 345 and 353), reaching the conclusion that all trustworthy evidence, experimental and other, is at present opposed to the view that *O. coriacea* is involved in the transmission of the disease.

To the one case of mite infestation mentioned in Part I (p. 160) the following may be added:

2. A ♂ from San-Juan-de-Arama, Colombia, on *Crax nigra*, carried 2 ♀ mites, without eggs, on the right side of the abdomen, close to the preänal sclerite.

O. coriacea has now also been found infested with Laboulbeniales of the genus *Trenomyces*. A ♂ from Maracajú, Brazil, on *Crax* sp., carried a large patch of these fungi on the venter of the abdomen, close to the thorax.

I have seen puparia or full-grown larvae from Mexico and Bolivia. They show no essential difference in shape and hirsuteness from those known of other species in the genus. The fully sclerotized and colored puparium (Fig. 97*I*) is broadly elliptical, 3.5 mm. long and 2.4 mm. wide. The saddle between the two polypneustic lobes is somewhat deeper than in *O. bisulcata*. The hairs and punctures of the integument are as in *O. spinifera* and *O. fumipennis*, the hairs being long, thin and stiff, each at the tip with a pair of minute, diverging barbs, which break off very easily.

Affinities. In view of the peculiar interest attaching to this

species, it is here described more fully than its congeners.

Smallest species of *Olfersia*, with rather long and narrow wings; 3rd and 4th longitudinal veins bare; 2nd basal cell long, the anterior basal cross-vein very short and nearly vertical. Interocular face narrow, only slightly wider than an eye; upper orbits and occiput not appreciably produced behind; postvertex divided by a curved, transverse depression; combined lunula and frons longer and narrower than usual, with a broad, triangular apical notch. Antennae unusually short.

Male. Head and thorax dorsally yellowish-brown to pale mahogany, sometimes somewhat coppery, pale dirty-yellow ventrally; lower half of interocular face, occipital margin, a median longitudinal line on mesonotum, humeral callosities and dorsal area of anepisternum more or less testaceous. Legs testaceous, tarsi darker; claws black. Abdomen testaceous; posterior sclerites blackish-brown. Setae mostly black; those of frons and middle of mesonotum testaceous.

Head (Fig. 97*D*) elliptical seen in front, slightly wider across the eyes than high from occiput to base of palpi. Posterior orbits very narrow, evenly curved, not projecting behind. Postvertex extending as one continuous, sclerotized plate from occiput to ptilinal suture, divided at its lower third by a crescent-shaped transverse depression, the anterior (or lower) area dull, microscopically alutaceous, the remainder smooth, shiny. Membranous mediovertex reduced to narrow lateral triangles. Sclerotized inner orbits narrow; inner margin with 8 to 10 soft, short setae, mostly placed in one row; one vertical bristle on each side near upper corner of postvertex. Occipital margin of postvertex evenly rounded, scarcely more projecting behind than upper orbits and separated from them by shallow inward curves. Combined lunula and frons (Fig. 84*B;* corrected from Fig. 7*F*) nearly as long as postvertex, basally with a large, deep median pit; anterior half divided longitudinally into two broad arms, which are contiguous over basal two-thirds and diverge at apex in two triangular, bluntly pointed lobes; surface of apical lobes flattened, slightly grooved, in part minutely striolate. Antennae much shorter than antennal pits; 1st segment completely divided by a deep suture from sides of frons; appendage of 2nd segment short, broadly rounded at apex, ending far from tip of apical lobe of frons, bearing many, very strong, curved setae. Palpi short and thick, protruding a short distance beyond frons, with a few, short setae. Eye broad; interocular face about $1\frac{1}{4}$ of the width of an

eye, the sides very slightly diverging toward occiput. Ventrally, postgenae on each side anteriorly with 1 strong seta and some soft hairs on the ridge bordering the buccal cavity; farther back, a few soft hairs and another strong seta about midway between buccal cavity and occipital foramen. Thorax (Fig. 97*C*): humeral callosities with the protruding lobes short, broad, very bluntly pointed, set off by an inner saddle-like depression, with a few scattered, black setae and 1 or 2 longer bristles; the inner area with a few setae and one long bristle; anterior margin of mesonotum slightly sinuate in the middle, the angles limiting the sinus very low and evenly rounded; transverse mesonotal suture deep, groove-like, but much finer medially; median notal suture a slightly raised line; prescutum with few, weak, pale setae anteriorly on the sides behind the incomplete posthumeral suture; notopleural lobe (at outer hind angle of prescutum) short, broad, bearing one very long bristle; mesoscutum with one postalar bristle, one long, pale hind dorsal bristle and a few minute setae nearby; dorsal area of anepisternum narrow, with prominent, broadly rounded hind angle, bearing scattered, short, black setae (mesopleural bristles), the setae stronger on the hind angle where one of them is very long. Disk of scutellum bare; hind margin sparsely fringed with soft, short hairs. Inner free process of metathoracic pleurotergite (Fig. 97*F*) long, narrow, blunt at tip. Thorax ventrally almost bare; intercoxal lobes of prosternum with a pair of long, soft setae; a similar seta on each side of mesosternum some distance from mid coxa. Legs covered fairly uniformly and sparsely with short hairs; fore coxa with a row of 4 setae ventrally; fore femur dorsally with a longitudinal row of 4 setae in the apical half anteriorly and, about the middle, with a transverse row of 2 or 3 shorter setae; outer face of fore tibia with a row of 4 or 5 long, soft setae; femora of mid and hind legs with a similar arrangement of weaker setae; apical spur of all tibiae short but strong, weakest on fore tibia; hind tibia in addition with an apical comb of short, strong setae. Wing (Figs. 97*A–B*) about 3 times as long as wide, slightly smoky, with a yellowish tinge; veins testaceous; membrane mostly covered with microtrichia, both on upper and under surfaces; only entire postaxillary cell, alula and a narrow zone (covering about $\frac{1}{5}$ of cell, but not reaching the base) along inner hind margin of combined 3rd posterior, anal and axillary cells bare; costa densely covered with short setae in its apical $\frac{2}{3}$, sparsely setulose at base; other veins bare; subcosta complete, ending in costa nearly opposite anterior basal cross-vein; 1st longitudinal reaching costa a

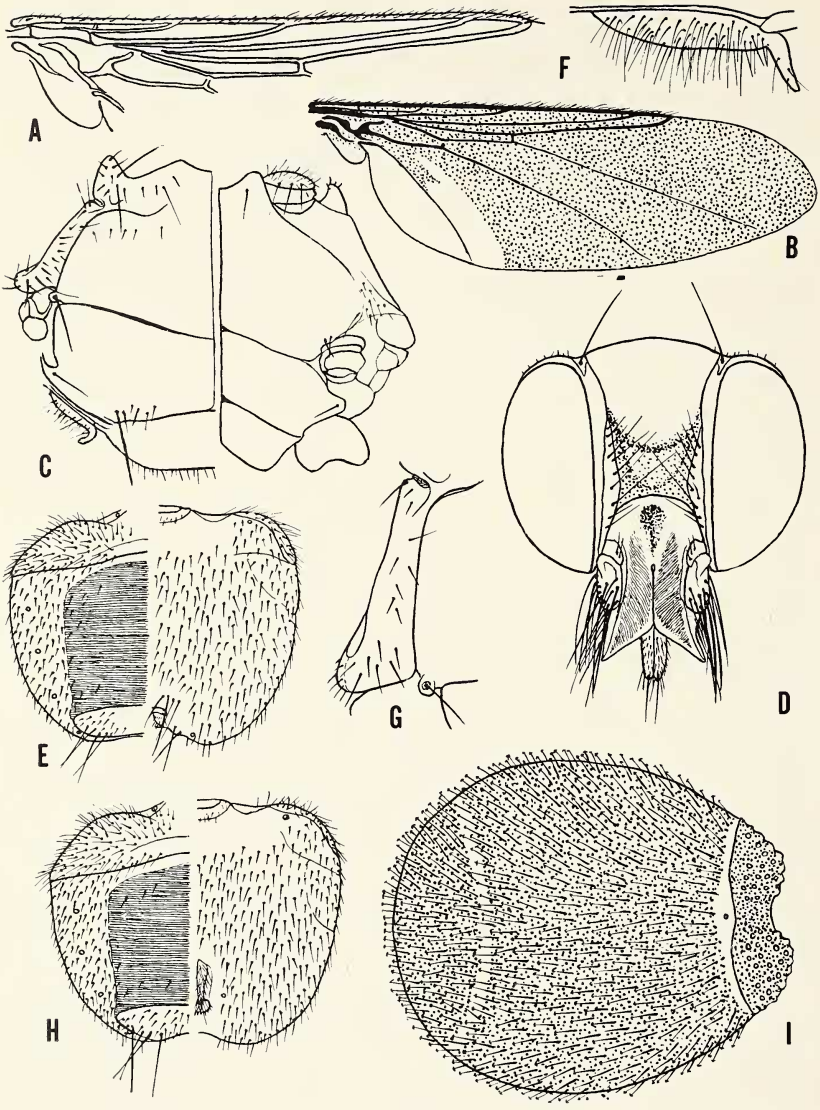

Fig. 97. *Olfersia coriacea* van der Wulp. **A**, anterior part of wing, the microtrichia omitted, ♂, Essequibo River; **B**, wing of same; **C**, thorax dorsally and ventrally, ♀, Maracajú, on *Crax* sp.; **D**, head, ♀, Gallon Jug, on *Agriocharis ocellata;* **E**, abdomen dorsally and ventrally, ♀, Yaloche; **F**, left metanotal pleurotergite of same; **G**, dorsal aspect of left anepisternum of same; **H**, abdomen dorsally and ventrally, ♂, Hato Frontera, on *Penelope purpurascens;* **I**, puparium from fly with same data.

short distance basad of anterior cross-vein; 2nd longitudinal ending much nearer tip of 3rd than of 1st; 1st basal cell very narrow, parallel-sided; 2nd basal cell rather long, nearly parallel-sided, about as long as its distance from the anterior cross-vein. Abdomen (Fig. 97*H*): combined 1st and 2nd laterotergites forming one transverse plate, with a median, rather deep inward curve, bare in the middle, the sides covered with scattered hairs; no small median sclerites behind this; preänal tergite large, strongly sclerotized, smooth and shiny, elliptical, divided medially by a slight, longitudinal, saddle-shaped depression, covered uniformly with sparse, short hairs and on each side before the apical margin with a transverse row of 3 or 4 long setae; remainder of dorsum soft, without sclerotized plates, but with a large median, almost bare area covered with very fine transverse striations; the sides with scattered, short hairs; venter soft, uniformly but sparsely covered with short hairs; genitalia as in other species of the genus. In addition to the hairs and bristles, dull, pollinose patches of dense, soft, microscopic, appressed hairs, on the following parts of head and thorax: inner, bristly portion of antennal appendage; area bearing inner orbital bristles; area around vertical bristle; inner saddle setting off humeral lobes; a narrow transverse area behind posthumeral suture; groove of transverse mesonotal suture; a small area on each side before scutellum; most of dorsal anepisternum; and much of mesopleura.

Length (from tips of palpi to hind margin of scutellum), 3 mm.; of wing, 6.5 to 7 mm.; width of wing, 2 to 2.5 mm.

Female. Differing from the male only as follows. Basal tergite of abdomen shorter; preänal tergite shorter, more transverse, posteriorly on each side with a group of 4 or 5 long setae.

Length (from tips of palpi to hind margin of scutellum), 3.5 mm.; of wing, 6.8 to 8 mm.; width of wings, 2.2 to 3 mm.

Original description of *O. coriacea:* "Brown, with the legs rufous and the wings brownish; first vein ending above the small cross-vein; third vein reaching the costa at three-fourths of its length. Length 4–5 mm. Dark brown; the eyes, the front [interocular face] (except its middle part), and the thorax glossy. Thorax before the transverse suture with two impressions on the disc; on the shoulders a rufous coniform prominence, with some short bristles at the tip; before the scutellum a longitudinal impressed line and on each side a rather deep impression with some small scratches. Legs rufous, the third femora elongate. Wings brownish; first vein ending above the small [anterior] cross-vein, which stands nearly at the middle of the wing's length, the auxiliary vein [subcosta] ending much nearer the base of the wing; third vein reaching the costa at three fourths of its length; second basal cell half as long as the superior [first] basal cell; beneath the end of the third vein a brown oblique shadow (in one of the specimens this is very distinct, in the other it is less conspicuous)." The original two cotypes, seen at the British

Museum in 1951, are, as Austen (1903) recognized, not cospecific, belonging even to different genera. The male from Guatemala, selected by Austen as the holotype and from which v. d. Wulp's figures were drawn, is the species of *Olfersia* common on game birds in tropical America. According to Dr. G.B. Fairchild, who examined it again in November, 1953, the wing is 7 mm. long, with a complete subcosta.

Original description of *P. meleagridis* (translated from the Portuguese): "General color that of coffee with a little milk added; similar to the *Lynchia* of domestic pigeon [*Pseudolynchia canariensis*], but with the characters of *Pseudolfersia* [=*Olfersia*]. Length 5 mm.; of head and thorax 3 mm. Head rather widened. Palpi blackish, a little shorter than half the head. Process of clypeus [frons] long, ending in two points, which are a little elongate and very divergent. Antennae with tufts of dark hairs. Triangles of frons [face] rounded, shaped like a half-moon or a segment of a circle; anterior triangle pale mahogany, with a darker and rather deep median depression; posterior triangle darker, particularly over the anterior half, and without anterior incision; lateral margins of frons [inner orbits] convex toward the inside with a row of small bristles and a larger one behind. All these parts polished and shiny; remainder of frons [face] with the surface finely granulose, about as long as wide. Eyes small, dark, but with a glossy sheen, slightly converging anteriorly. Occiput laterally with short black spines, medially with fine light bristles. Under side of head light ochraceous-gray, somewhat granulose, with some dark long bristles. Mesonotum with a metallic greenish gloss, rather smooth, but with many microscopic furrows which, under low magnification, recall fine fingerprints and run obliquely from the corners to the center. Median notal suture broad and shallow, consisting of a polished strip, bordered on each side by a deeper line; it shows sometimes a median reddish line and extends over the entire notum, but does not continue over the scutellum. Transverse mesonotal suture forming a very obtuse angle, opening forward; deep on the sides, superficial or effaced medially. Humeral callosities subconical, more or less grayish-ochraceous, with short black subterminal spines and near the middle a long dorsal bristle. Spiracle forming an indistinct notch on the lower outer side of the callosity. Lath-shaped side margins of prescutum with some black bristles; hind part of posthumeral callus forming a subconical protuberance bearing spines and one black bristle; directly behind this, the anteälar callus forms another protuberance without spines or bristles; hind margin of scutum on each side with a long bristle. Surface of scutellum either colored like the scutum or light-ochraceous, entirely or at the margins only; anterior margin somewhat convex; posterior margin truncate or slightly sloping medially, disclosing beneath it the metathorax and on the sides the squamular processes; margin of scutellum with a row of short and fine bristles. Under side of thorax ochraceous, with light reflexions. Abdomen generally dark colored, with scattered fine hairs and some larger postero-lateral bristles, usually 4 on each side. Legs light ochraceous-gray; knees and tips of tarsi darker; fore coxae shaped like large vesicular tubercles, with granulose surface, bearing sparse, short black hairs, which become longer on the under side. Median empodium large, curved and feathery; lateral empodia [pulvilli] half-moon-shaped, excavated. Claws black, with a long black tooth and an elongate, yellowish basal tubercle. Wings of the typical shape; yellow ground-color showing only in the axillary cell and in the anal cell over an area bordering the two-thirds away from the anal vein; the remainder infuscated through microscopic hairs, placed close together; large veins light chestnut." Although this description mentions few truly diagnostic characters, it applies well to *O. coriacea*. The size is particularly helpful, since *coriacea* is the only known small species in the genus. Moreover, I have studied at the U.S.N.M. a ♂, labelled *P. meleagridis* by Ad. Lutz and sent by him to the late J.M. Aldrich, from Pernambuco, taken on domestic turkey. This ♂, one of the original cotypes, agrees with what is called here *O. coriacea*.

3. Subfamily Melophaginae
Neolipoptena J. Bequaert, 1942

Neolipoptena J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 47 (monotypic for *Lipoptena ferrisi* J. Bequaert, 1935).

The only known species of *Neolipoptena* is restricted to western North America. The genus was described in detail in 1942.

Neolipoptena ferrisi (J. Bequaert)

Figs. 98*A–G*

Lipoptena subulata Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 187, figs. 2*C* and 4. Herms, 1950, Medical Entomology, 4th Ed., p. 412 (with *L. ferrisi* as synonym). Not of Coquillett, 1907.

Lipoptena ferrisi J. Bequaert, 1935, Bull. Brooklyn Ent. Soc., **30**, p. 170 (new name for *Lipoptena subulata* Ferris and Cole, 1922). Essig, 1942, College Entomology, p. 815.

Neolipoptena ferrisi J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 48, figs. 4*A–F* (with detailed bibliography and locality records). Herman, 1945, California Fish Game, **31**, pp. 17 and 20 (California: Ravendale and Susanville, Lassen Co., on *Antilocapra americana;* not the figures). Hare, 1945, Pan-Pacific Entom., **21**, p. 49 (California: Lake Co.; Ventura Co.). Cowan, 1946, Canad. Jl. Res., Ser. D, **24**, p. 77. Longhurst and Douglas, 1953, Trans. 18th North Amer. Wildlife Conf., pp. 177 and 184 (California: Hopland, Mendocino Co., on *Odocoileus hemionus columbianus*). Linsdale and Tomich, 1953, A Herd of Mule Deer, p. 230 (California: Hastings Reservation near Jamesburg, Monterey Co., on *O. h. columbianus.* Bionomics).

In addition to the generic characters mentioned in the key (Pt. II, p. 22), *N. ferrisi* differs from the 4 American species of *Lipoptena* in having from 15 to 20 setae on each inner orbit, some of these setae being placed above the eyes. The mid tibia has only one apical spur and the junction of costa and 3rd longitudinal vein is swollen and knob-like.

Distribution and Additional Records (since 1942). Dominion of Canada. British Columbia (recorded by Spencer, 1938, 1939; J. Bequaert, 1942): Pender I. (G.J. Spencer); Cobble Hill, on *Odocoileus hemionus columbianus* (I.McT. Cowan); Coxnox area, 100 miles N. of Nanaimo, Vancouver I., on *O. h. columbianus* (G.J. Spencer).

United States. California (recorded by Ferris and Cole, 1922, as *L. subulata;* J. Bequaert, 1942; Herman, 1945; Hare, 1945; Longhurst and Douglas, 1953; Linsdale and Tomich, 1953): Alturas, Modoc Co. (C. Griner); Redwood Creek, Humboldt Co., on *O. h. columbianus* (H.S. Barber); Hallelujah Junction, Lassen Co. (E.I. Schlinger); Ravendale, Lassen Co., 1 winged ♀ on *Antilocapra americana,* Sept. 18 (G.H. True, Jr.); Susanville,

Lassen Co., 1 ♀ and 1 ♂, both deälated, on head of *Antilocapra americana*, Sept. 13 (C.M. Herman); Dos Rios, Mendocino Co. (I.B. Tarshis); Black Diamond Mt., Glenn Co. (I.B. Tarshis); Wilbur Springs, Lake Co. (I.B. Tarshis); Nice, Lake Co. (A.W. Lindquist); Colusa, Colusa Co. (I.B. Tarshis); Truckee, Nevada Co., on *O. h. hemionus* (E.I. Schlinger); Pollock Pines, Eldorado Co. (A.T. McClay); Chino Flat, Eldorado Co. (L.W. Quate); Snowline, Eldorado Co. (J.S. MacSwain); Mill's Valley, Marin Co. (H.B. Leach); Marin Co., on *O. h. columbianus;* Mt. Diablo, Contra Costa Co. (F.X. Williams); Pinecrest, Tuolumne Co. (P.H. Arnaud, Jr.); Topaz Lake, Mono Co. (R. Coleman); Big Pine Creek, Inyo Co. (R.M. Bohart); Santa Barbara, Sa. Barbara Co.; Angelus Crest, Palmdale Highway, 4000 ft., Los Angeles Co. (W.A. McDonald); Tanbark Flat, Los Angeles Co. (W.A. McDonald); Cabazon, Riverside Co., on *O. h. californicus* (D.G. Hall); Palomar Mountain, San Diego Co., on *O. h. californicus;* Vandeventer Flat, San Jacinto Mts., Riverside Co. (E.G. Linsley); Cleveland National Forest, San Diego Co., on *O. h. californicus* (H. Owen); [previously recorded also from Tehama, Plumas, Mariposa, Madera, Monterey, Fresno, Tulare, Ventura, and San Bernardino Counties]. — Montana (recorded by J. Bequaert, 1942): Medicine Springs, Ravalli Co., on *O. h. hemionus* (W.J. Jellison and Sargent); White Sulphur Springs, Meagher Co., 110° W., on *O. h. hemionus*, Nov. (C.B. Philip); Snowy Mts. near Roundup, Ravalli Co., on *O. h. hemionus*, Oct. 25 (C.B. Philip). — Oregon (recorded by J. Bequaert, 1942): Curry Co.; 10 miles W. of Philomath, Benton Co. (V. Roth); Bly, Klamath Co., on *O. h. hemionus* (A. Walker). — South Dakota: Spearfish, Lawrence Co., on *O. h. hemionus*, Nov. 10 (P. Kohler); Black Hills, Lawrence or Pennington Co., about 103° 30′ W., on *O. v. leucurus*, Nov. (C.L. McGuigain). — Washington (State): Addy, Stevens Co., 10 deälated specimens, together with 2 *L. depressa*, on one *O. h. hemionus* (J. Hatter); La Grange, Goshen Co. (R.L. Furness); Elk, Teton Co. (R.L. Furness); Elbe, Pierce Co. (R.L. Furness); Winthrop, Okanagan Co., on *O. h. hemionus*, Oct. 12 (G.E. Quinby). — Wyoming (recorded by J. Bequaert, 1942): Sheridan, Sheridan Co., 107° W. (R. Cooper).

Mexico: La Laguna, Sierra Laguna, Baja California (E.S. Ross and R.M. Bohart).

N. ferrisi is restricted to western North America, where its known range covers southern British Columbia (northward to 51°), the State of Washington, Oregon, Wyoming, Montana, west-

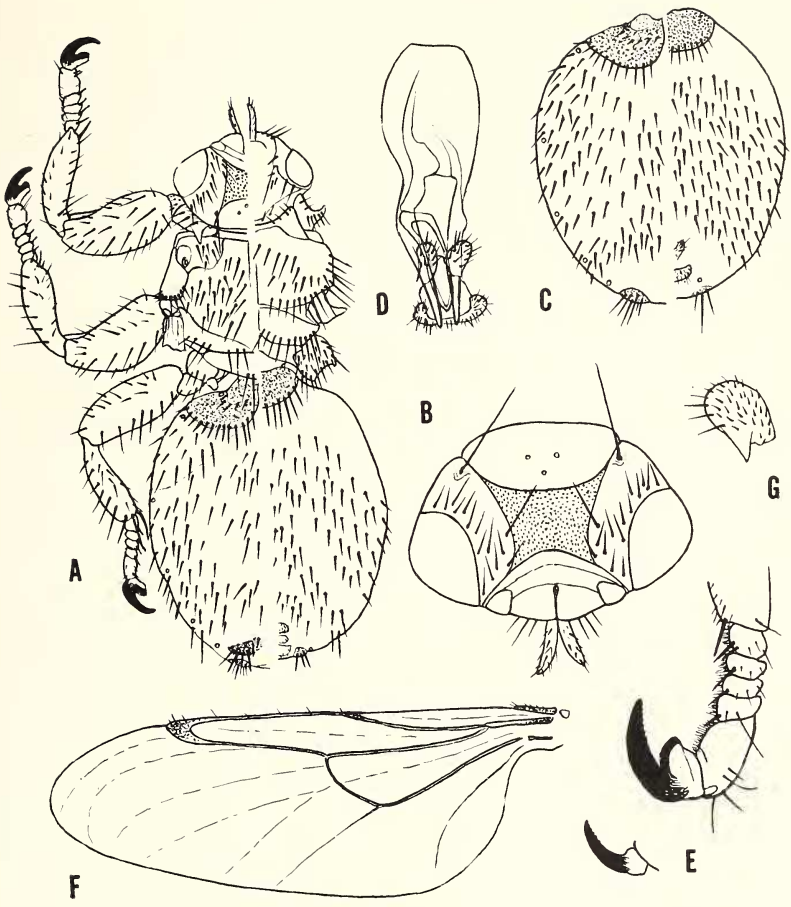

Fig. 98. *Neolipoptena ferrisi* (J. Bequaert), Palomar Mountain, California, on *Odocoileus hemionus californicus:* **A**, body dorsally and ventrally, ♀; **B**, head, ♀; **C**, abdomen dorsally and ventrally, ♂; **D**, ♂ terminalia; **E**, tarsus and claws (inner and outer) of fore leg, ♀; **F**, wing, ♀; **G**, fore coxa from above, ♀.

ern South Dakota, California and Lower California. The eastmost record is from South Dakota, near 103° 30′ W.

Bionomics. *N. ferrisi* is common on three of the races of *Odocoileus hemionus:* the Rocky Mountain mule deer, *O. h. hemionus,* the coastal black-tailed deer, *O. h. columbianus,* and the California black-tailed deer, *O. h. californicus.* The area covered by this ked practically coincides with that inhabited by *O. hemionus,* which I regard as its only true breeding host. In an earlier

paper (1942*a*, pp. 50–51) and in the present I list four records from the western white-tailed deer, *Odocoileus virginianus leucurus*, in Oregon, Montana, South Dakota and California; but I am inclined to regard these at best as accidental occurrences. I doubt that *N. ferrisi* could maintain itself in nature on white-tailed deer in the absence of *O. hemionus*. The species has recently been taken twice on prong-horn antelope, *Antilocapra americana*, a most interesting though presumably only a stray host. A stray specimen was also recorded from a quail, *Lophortyx californica*. Where it occurs, it is found together with *L. depressa*, though it is usually less abundant; but mixed infestations are not unusual. For instance, in a lot taken from a single deer at Pender Island, 291 were *depressa* and only 16 *ferrisi*. At the Hastings Reservation near Jamesburg, California, Linsdale and Tomich (1953, pp. 230–231) found that of 6,582 keds taken on 25 *O. h. columbianus* in 8 different months, 963, or 14.6 per cent, were *ferrisi*. The proportion of *ferrisi* was much lower among the volants captured in the open (0.5 per cent of 290 flies). Occasionally the two species were almost equally abundant on one host, a lot of 278 keds taken in August comprising 115, or 41.4 per cent, *Neolipoptena*. These authors were unable to detect differences in behavior or seasonal occurrence between the two species. Of 963 *ferrisi* taken on deer, 939 were found in July, August and September, and 22 in December; none occurred in January, May, October and November; September was the peak month.

Lipoptena Nitzsch, 1818

Hippobosca subg. *Lipoptena* Nitzsch, 1818, in Germar's Mag. der Entom., **3**, p. 310 (monotypic for *Hippobosca cervina* Nitzsch, 1818 = *Pediculus cervi* Linneaus, 1758).

Lipoptena J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 52 (full synonymy).

Additional synonyms not mentioned in 1942:

Lipoptenus Meinert, 1890, Entom. Meddel., Copenhagen, **2**, pt. 5, p. 216 (in the combination *Lipoptenus cervi;* error for *Lipoptena*).

Lypoptena Zavattari, 1928, Atti Soc. Italiana Sci. Nat., **67**, p. 43 (error for *Lipoptena*).

Lipopterna Wardle, 1936, General Entomology, p. 252 (error for *Lipoptena*).

Lipotina Cloudsley-Thompson, 1955, Science Progress, **43**, No. 172, p. 621 (error for *Lipoptena*).

The generic characters are given in my paper of 1942, where I divided the genus into 2 subgenera: *Lipoptena*, proper, containing most of the species, and *Lipoptenella* J. Bequaert, 1942. The number of apical spurs on the mid tibia can no longer be used as a subgeneric character, as *L. guimaraesi*, described below, has 3

apical spurs, while in every other character it is closely related to *L. depressa.*

Lipoptena is nearly world-wide in distribution, but is absent from Madagascar, Australia and New Zealand. I now recognize 15 valid species (including one undescribed from the Oriental Region), in addition to 3 doubtful forms. Of the 4 New World species, one (*L. cervi*) is a recent introduction by Man from the Old World and a *Lipoptena,* proper. The other 3 are autochthonous and precinctive, and belong in *Lipoptenella.* All 4 species agree in bearing relatively few setae on the inner orbits, none of the setae being found in the postero-lateral area above the eye. This peculiarity differentiates them from *Neolipoptena ferrisi* and is additional to the strictly generic characters mentioned in the key (Pt. II, p. 22).

In a further effort to dispel the persistent error that some of the *Lipoptena* use bats as normal or breeding hosts, I point out once more that all published records from such animals should be disregarded. In particular, the following names were based either on erroneous generic identifications or on unsubstantiated surmises of the host relations: *Lipoptena phyllostomatis* Perty (1833) was a streblid of the genus *Aspidoptera. Lipoptena pteropi* Denny (1843) was a true *Lipoptena,* to judge from the description and original figures; but the author's claim that he took it from "*Pteropus edulis*" must have been due to a confusion of labels or a faulty memory; no such fly has ever been seen among the many ectoparasites collected from this or any other East Indian bat during the past century. *Lipoptena dubia* Rudow (1871) was a streblid of the genus *Paradyschiria. Lipoptena tolisina* "Speiser", in Muir (1912), was an error for "*Listropoda tolisina*", one of the Nycteribiidae. Some of these names are discussed further in my Monograph of the Melophaginae (1942*a*, pp. 46 and 209–210). As for the supposed occurrences on birds, no doubt newly-emerged volants of *Lipoptena* may occasionally stray to them, as they will to Man or any moving object; but there is no reliable evidence that deer-keds ever attempt to bite birds or remain on them long enough to shed the wings (see J. Bequaert, 1942*a*, p. 75; the name of the European grouse given there as *Bonasa umbellus* should be corrected to *Tetrao urogallus*).

Key to American Species of *Lipoptena*

1. Median tergal plates of abdomen distributed over most of the length of the dorsum; 2nd basal pleurites (laterotergites)

broadly and briefly triangular, nearly trapezoidal. Apical spur of fore tibia stout, spine-like; mid tibia with 2 stout apical spurs. Wing with junction of costa and 3rd longitudinal vein simple, not knob-like ..... *L. cervi*

Median tergal plates of abdomen small, crowded near tip of dorsum (sometimes reduced to one); 2nd basal pleurites (laterotergites) elongate triangular. Wing (in *L. depressa* and *L. mazamae*) with junction of costa and 3rd longitudinal vein swollen, knob-like 2

2. Apical spur of fore tibia very thin, hair-like; mid tibia with one stout apical spur. Inner orbit with 3 to 6 setae, some very small. Disk of mesonotum on each side with a transverse group of setae connecting the median row of acrostichals with the mesopleurals (lateral prealar group). *L. depressa*

Apical spur of fore tibia stout, spine-like 3

3. Inner orbit with 1 or 2 setae. Disk of mesonotum extensively bare, the median row of acrostichals separated on each side by a bare area from the few setae placed near the mesopleurals. Mid tibia with one stout apical spur. *L. mazamae*

Inner orbit with 3 or 4 long setae. Disk of mesonotum on each side with a transverse group of setae connecting the median row of acrostichals with the mesopleurals. Mid tibia with 3 stout apical spurs, the median one long, the side ones much shorter ..... *L. guimaraesi*

Subgenus *Lipoptena*, proper

Lipoptena cervi (Linnaeus)
Figs. 13*B* and 99*A–G*

Pediculus cervi Linnaeus, 1758, Syst. Nat., 10th Ed., 1, p. 611 (in part; no sex; "in *Cervo elapho, dama, capreolo*"; without description, but with several references, including one to a figure of the deer-ked by Frisch, 1736; no locality, but evidently from Europe).[63]

[63] As pointed out in 1942, Linnaeus based his *Pediculus cervi* of 1758 on references to published figures only and it is doubtful that he ever saw specimens. Dr. F. Bryk recently (June, 1950) wrote me that there are no Linnaean specimens of *L. cervi* in any Swedish collection. The deer-ked occurs, however, in southern Sweden, where it was first definitely recorded by Zetterstedt (1848). When Linnaeus included *Pediculus cervi* in the 2nd Edition of his Fauna Suecica (1761, p. 71), he restricted the name to Frisch's

Lipoptena cervi J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 58, figs. 5*A–G* (with detailed bibliography and records). Bump, 1941, **30th** Ann. Rept. New York State Conserv. Dept., (for 1940), p. 224 (New York State). Webber, 1950, in Craighead, Insect Enemies Eastern Forests, U.S. Dept. Agric. Misc. Publ. No. **657**, (for 1949), p. 529. Kettle and Utsi, 1955, Parasitology, **45**, Nos. 1–2, p. 119 (in Scotland, infesting imported reindeer).

Haemobora pallipes Curtis, 1824, British Entomology, **8**, Pl. 14 (first printing, with letterpress; plate dated March 1, 1824. ♂; on Man. New Forest, England); 1834, *Op. cit.*, **8**, Pl. 14 (second printing, with altered letterpress); 1829, Guide Arrangement British Insects, column 242; 1837, *Op. cit.*, 2nd Ed., column 278. Stephens, 1829, Syst. Cat. Brit. Ins., **2**, p. 327. Walker, 1853, Insecta Britannica, Dipt., **2**, p. 288; Pl. 20, fig. 4. White, 1854, List Spec. Brit. Anim. Brit. Mus., **15**, p. 41. Wood, 1872, Insects at Home, p. 643, cut LXXVIII, figs. 1 and 1*a–c*. Blackwelder, 1947, Smithson. Misc. Coll., **107**, No. 5, pp. 22 and 23 (facsimile reproductions of 1st and 2nd printings of Curtis' text).[64]

Ornithobia pallida ["M." Curtis, 1829, Guide Arrangement British Insects, column 242; *nomen nudum*]. Meigen, 1830, Syst. Beschreib. Europ. Zweifl. Ins., **6**, p. 230; Pl. 63, figs. 21–24 (no sex; no host; Germany. Type lost). Curtis, 1837, Guide Arrangement British Insects, 2nd Ed., column 278. Theobald, 1896, Parasitic Diseases Poultry, pp. 34 and 35, fig. 10 (supposed occurrence on fowls; an unreliable record).

Lipoptena subulata Coquillett, 1907, Ent. News, **18**. p. 290 (♀ ♂; on deer. New Hampshire: Woodstock. Holotype ♀, No. 10292, and 5 paratypes (4 ♀, 2 on a slide, and 1 ♂) at U.S.Nat.Mus.). Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303.

References to other European synonyms, *Ornithomyia nigrirostris* v. Roser (1840), *Lipoptena alcis* Schnabl (1881) and *Lipoptena cervi* var. *obscura* Lühe (1906), in my Monograph (1942*a*). The erroneous South American references to *L. cervi*, based on specimens of *L. mazamae*, are listed under that species.

Distribution in America and Additional Records (since 1942). United States. Massachusetts (recorded by Johnson, 1925, as *L. subulata;* J. Bequaert, 1942). — New Hampshire (recorded by Coquillett, 1907, as *L. subulata;* Johnson, 1925, as *L. subulata;* J. Bequaert, 1942): Corbin Park near Newport, Sullivan Co., on *Cervus canadensis* in captivity, Nov. 2, 1942 (R.C. Morrill); Croydon, Blue Mt. Forest, Sullivan Co., on heavily infested *Odocoileus virginianus borealis*, Dec. 29, 1950 (R.G. Carpenter). — New York (recorded by Gerberg and Goble, 1941; J. Bequaert,

figure, but without a word of description, further proof it would seem that he never saw a specimen.

[64] These references should replace those given for *H. pallipes* in my Monograph (1942*a*, p. 65), which are incomplete and misleading. I was not aware at the time of the two printings of Curtis' original description. The text I quoted (1942*a*, p. 78) was from the second printing, that of the first printing being copied below.

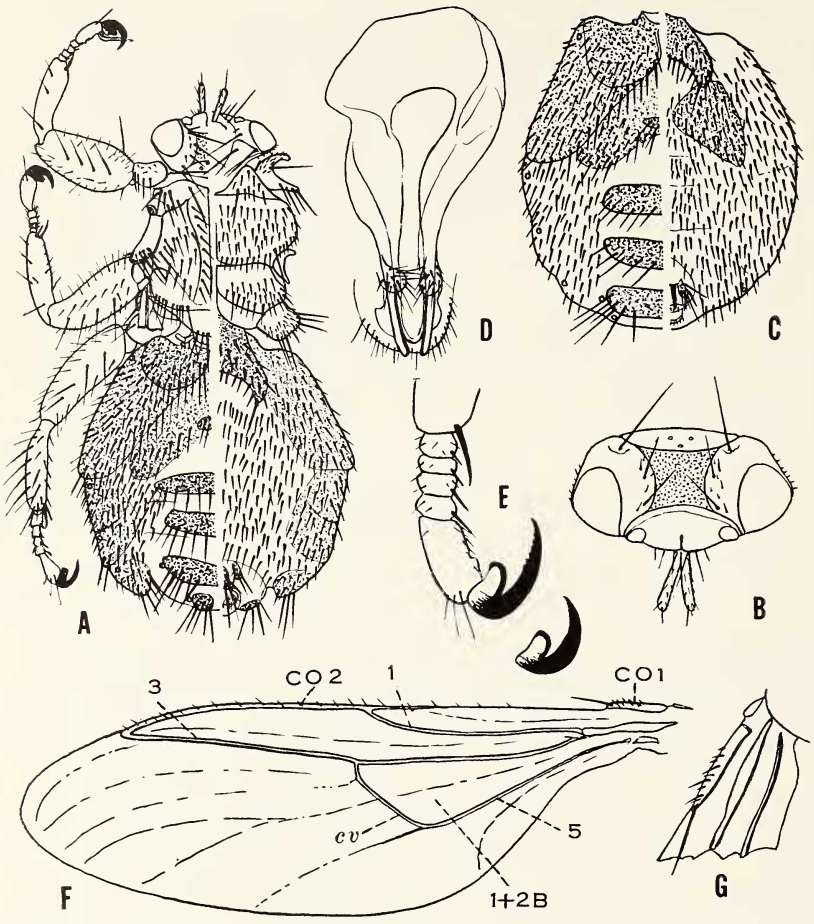

Fig. 99. *Lipoptena cervi* (Linnaeus). **A**, body dorsally and ventrally, ♀, Woodstock, New Hampshire, on deer (paratype of *L. subulata* Coquillett); **B**, head, ♂, Recey-sur-Ource, France, on *Capreolus capreolus;* **C**, abdomen dorsally and ventrally, ♂, same data; **D**, ♂ terminalia, same data; **E**, tarsus and claws (inner and outer) of fore leg, ♂, same data; **F**, wing of volant ♂, Parcé, France: *1, 3* and *5*, 1st, 3rd and 5th longitudinal veins; *1+2B*, combined 1st and 2nd basal cells; *CO1* and *CO2*, basal and apical sections of costa; *cv*, combined anterior and anterior basal cross-veins; **G**, basal stump of wing, deälated ♀, Woodstock.

1942): on dead deer brought to Albany, Albany Co., Nov. 18, 1938 (A. Paladin); W. side of Racquet Lake, Long Lake, Hamilton Co., on *O. v. borealis,* Nov. 7–9, 1954 (J. Heller); Allegany Park, Cattaraugus Co., on *O. v. borealis,* Nov. 13, 1949 (W.J. Hamilton, Jr.). — PENNSYLVANIA (recorded by J. Bequaert, 1942): McKean

Co., Dec. 1953 (H. Groves); Cameron Co., Dec. 1953 (H. Groves); [said to occur commonly in Cameron Co. on deer and wapiti].

L. cervi is an Old World species introduced accidentally by Man into the northeastern United States some time prior to 1907. It is now well established on native hosts in New Hampshire, Massachusetts, New York and Pennsylvania. It is widely distributed in the Palearctic Region, from the British Isles (including Ireland) to eastern Siberia and northern China, northward to southern Sweden and Esthonia, southward to Algeria.

In my Monograph (1942*a*, p. 71) I discussed the published records of *L. cervi* from outside the Palearctic and Nearctic Regions, concluding that all were based on misidentifications. I did not include Hennig's (1941*a*, p. 177) record from Formosa (Chip Chip), based on an identification by Schuurmans Stekhoven, which may or may not be correct.

In the eastern United States *L. cervi* has been taken thus far on northern Virginia deer, *Odocoileus virginianus borealis*, and on wapiti, *Cervus canadensis*. The host relations and life-history were fully treated in my Monograph (1942*a*, pp. 71–76) and there are references in Part I to the following topics: symbiotic microorganisms (p. 103), mechanism of feeding (p. 109), frequency of meals (p. 113), sex ratio (p. 177), larviposition (p. 186), abnormal hosts (pp. 217–218), location of hosts (p. 221), population dynamics (p. 228), acquisition of new hosts (p. 246), host relations (pp. 288 and 319), and attacks upon Man (pp. 339–340). With regard to the ease with which *L. cervi* has adopted American wild deer as new hosts, the following recent occurrence is of some interest. As part of an attempt to introduce the northern European reindeer, *Rangifer tarandus*, from Lapland to the Highlands of Scotland, some of these animals are now kept under close supervision near Rothiemurchus, Inverness-shire, particular attention being paid to their parasites. According to Kettle and Utsi (1955), a few months after the arrival of the animals they were found to be heavily infested with the native British deer-ked, *Lipoptena cervi*, specimens of which were sent to me by Dr. D.S. Kettle. It is particularly noteworthy in this connection that deer-keds have never been recorded from reindeer in their natural Old World range, nor from its North American representative, the caribou.

The only description and figure of the puparium of *L. cervi* I was able to trace, are by Eleanor Ormerod (1898, as *Lipoptera cervi*), reproduced later by Wallace (1904).

Original description of *Haemobora pallipes* Curtis (first printing, 1824):

"Shining, with strong hairs scattered over the limbs and body; pale and dull; greenish-yellow clouded with brown. Eyes and claws black. Thorax beneath punctured and covered with short, strong erect hairs. Wings nearly transparent, nerves yellow, the costa slightly ciliated." Additional specific characters are contained in the generic diagnosis: "Antennae inserted close to the anterior angles of the clypeus, globular, hairy, and sunk into the head. Labrum horny, elongate, hollow, slightly arcuated, inclosing the tongue. Tongue nearly as long as labrum, slender. Lip horny, arched, hollow, inclosing the labrum and tongue. Maxillae? rigid, obtuse, ciliated with strong hairs, united at their internal edges, bent downwards, inclosing the proboscis, and extending beyond the head like a beak. Mentum large, coriaceous, membranaceous, covering and concealing the base of proboscis. Ocelli 3, in a triangle, sunk in foveolae. Wings very long, rounded, first marginal or mediastinal cell extending one-third the length of the wing; second marginal cell very long, rounded at the end, discoidal cells united, 6 obscure, imperfect nerves extending to posterior margin. Tarsi 5-jointed, last the longest; Claws, lengthened at their base on each side the pulvillus. Head broader than long, somewhat triangular, divided from the thorax. Eyes very remote, small. Thorax a little broader than head, nearly quadrate, dilated near the base of wings, notched anteriorly. Scutellum broad and short. Halteres very distinct. Abdomen small, nearly conical, peduncled, coriaceous towards its base, the remainder spongy. Feet extended, thick, first pair remote from the wings, inserted almost under the head." A comparison of these quotations with those of the second printing, given in my Monograph (1942*a*, pp. 78–79), shows that the differences are trivial. I have not copied the statements relative to larva and pupa in the first printing (omitted in the second printing), because they were taken from Latreille and do not refer specifically to *Haemobora*.

Subgenus *Lipoptenella* J. Bequaert, 1942

Lipoptena subg. *Lipoptenella* J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, pp. 47, 55 and 118 (type by original designation: *Melophagus depressus*, Say, 1823).

Lipoptena (*Lipoptenella*) *depressa* (Say)
Figs. 11*A–B* and 100*A–F*

Melophagus depressus Say, 1823, Jl. Ac. Nat. Sci. Philadelphia, **3**, p. 104 (no sex; on "*Cervus virginianus*" [=*Odocoileus virginianus*]. North America, without precise locality; possibly from Colorado. Type lost).

Lipoptena depressa J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 118, figs., 1*E–F* and 11*A–F* (with full bibliography and locality records).

The following references were not mentioned in 1942.

Lipoptena depressa Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303. Herms, 1915, Medical Veterinary Entomology, p. 295, fig. 186; 1923, *Op. cit.*, 2nd Ed., p. 350, fig. 187. Craig, 1923, in Wooldridge, Encyclopaedia Veterinary Medicine, **1**, Veter. Med., p. 500. J.H. Comstock, 1924, Introduction to Entomology, p. 875 (also in 1940 printing, p. 875). Essig, 1942, College Entomology, p. 815. Cowan, 1943, Canad. Jl. Res., Ser. D, **21**, pp. 180–186 (British Columbia: southern Vancouver I. Life-history). Steinhaus, 1943, Jl. of Parasitology, **29**, p. 80 (Montana: Hamilton. Rod-like bacteria in intestinal tract). Herman, 1945, California Fish Game, **31**, p. 17. Hare, 1945, Pan-Pacific Entom., **21**, pp. 48–57 (bionomics of volants. California: Binkley Ranch near Kelseyville, Lake Co.; 17-mile Drive, Carmel, Monterey Co.; Sespe Gorge near Ojai, Ventura Co.; Mt. Diablo,

Contra Costa Co.; Redwood and Strawberry Canyons, Alameda Co.); 1945, Summary of Dissertation, Berkeley, Calif., p. 1. Cowan, 1946, Canad. Jl. Res., Ser. D, **24**, p. 77. Steinhaus, 1946, Insect Microbiology, pp. 44, 206, and 245, fig. 15 (infection with an intracellular bacterium, *Corynebacterium lipoptenae* Steinhaus). Shaw, 1947, Oregon Agric. Expt. Sta., Techn. Bull. **11**, p. 5 (Oregon).[65] Florenzano, 1949, Redia, Florence, (2), **34**, p. 143 (*Corynebacterium lipoptenae*). Herms, 1950, Medical Entomology, 4th Ed., p. 412, fig. 137. Holdenried, Evans and Longanecker, 1951, Ecological Monographs, **21**, pp. 11 and 14 (California: Calaveras Dam, Alameda Co., on *Odocoileus hemionus columbianus*). Hennig, 1952, Larvenformen der Dipteren, **3**, p. 402. Hare, 1953, Microentomology, **18**, pt. 2, pp. 38–51, figs. 16–18 (California: Carmel; Mt. Diablo; Strawberry Canyon. Bionomics). Longhurst and Douglas, 1953, Trans. **18th** North Amer. Wildlife Conf., pp. 177 and 184 (California: Hopland, Mendocino Co., on *O. h. columbianus*). Linsdale and Tomich, 1953, A Herd of Mule Deer, pp. 230–236 (California: Hastings Reservation near Jamesburg, Monterey Co., on *O. h. columbianus*. Bionomics).

Lipoptera depressa Zebrowski, 1932, Audubon Year Book, Indiana Audubon Soc., p. 48.

Neolipoptena ferrisi Herman, 1945, California Fish Game, **31**, p. 17, figs. 9*A–C* (♀, volant, puparia). Not of J. Bequaert, 1935.

Distribution and Additional Records (since 1942). Dominion of Canada. British Columbia (recorded by Ferris and Cole, 1922; Spencer, 1938, 1939; J. Bequaert, 1942): Hardy I., on *Odocoileus hemionus columbianus* (G.J. Spencer); Wellington (R. Guppy); Robson (H.R. Foxlee); Duncan, Vancouver I., on *O. h. columbianus* (G.J. Spencer); Cobble Hill, on *O. h. columbianus* (I.McT. Cowan); Coxnox [not "Comox," as in 1942], 100 miles N. of Nanaimo, Vancouver I., on *O. h. columbianus* (G.J. Spencer); Vernon, on *Odocoileus h. hemionus* (S. Peters); Goldstream Lake, on *O. h. columbianus;* Crofton, on *O. h. columbianus* (I.McT. Cowan); Victoria, on *O. h. columbianus;* Cowishan, Vancouver I., on *O. h. columbianus* (G.C. Carl); Mt. Lehman, on *Odocoileus virginianus leucurus* (received from G.B. Thompson); Kotenay, on *O. v. leucurus* (G.J. Spencer); Pender I. (G.J. Spencer).

United States. California (recorded by Coquillett, 1907; Clarke, 1913; Ferris and Cole, 1922; O'Roke, 1936; J. Bequaert, 1942; Hare, 1945, 1953; Holdenried, Evans and Longanecker, 1951; Longhurst and Douglas, 1953; Linsdale and Tomich, 1953): Alturas, Modoc Co. (C. Griner); Redwood Creek, Humboldt Co., on *O. h. columbianus* (H.S. Barber); Hat Creek, Shasta Co. (R.L. Hall); Buchnell Creek, Mendocino Co. (K. Hagen); Hopland, Mendocino Co., on *O. h. columbianus* (W.M. Longhurst); Dos Rios,

[65] The reference in my Monograph of the Melophaginae to Shaw, Dixon and Huth, 1934, should be corrected to: Shaw, Simms and Muth, 1934, Oregon Agric. Expt. Sta., Station Bull. **322**, p. 21.

Mendocino Co. (I.B. Tarshis); Rancheria Creek near Boonville, Mendocino Co. (C.I. Smith); Wilson Lake, Tehama Co., on *O. h. columbianus* (Bischoff, Rosen and Tegen); Red Bluff, Tehama Co., on *O. h. columbianus* (J.J. du Bois and B. White); Palegreen's Place, Tehama Co., on *O. h. columbianus* (I.B. Tarshis); Paynes Creek, Tehama Co. (P. Oman); Quincy, Plumas Co., on *O. hemionus* (E.W. Jameson, Jr.); Seneca, Plumas Co., on *O. h. columbianus* (H.S. Barber); Black Diamond Canyon, Glenn Co. (I.B. Tarshis); Dasman Land, South Fork, Scott Creek, Cow Mt., Lake Co., on *O. h. hemionus* (J. Azevedo); Nice, Lake Co. (A.W. Lindquist); Truckee, Nevada Co., on *O. h. hemionus* (E.I. Schlinger); Santa Rosa, Sonoma Co. (K. Frick); Green Valley, Sonoma Co. (J.E. Gillaspy); Petrified Forest, Sonoma Co. (R.M. Bohart); Yountville, Napa Co., on *O. h. columbianus* (O. Brunetti); Hills above Capay, Yolo Co., emerged from puparium found in grass stem, Sept. 28; Pyramid Ranger Station, Eldorado Co. (J.W. MacSwain); Snowline Camp, Eldorado Co. (J.W. MacSwain); Pleasant Valley, Eldorado Co., volant, Oct. 7 (W.L. Nutting); River Pine, Amador Co., volant, Nov. (C.P. Felmley); Mt. Tamalpais, Marin Co. (Norland); Marin Co., on *O. h. columbianus;* Inverness, Marin Co., one volant on *Sitta pygmaea,* Sept. 5 (R.A. Norris); Mt. Diablo, Contra Costa Co. (E.I. Schlinger); Orinda, Contra Costa Co. (E.C. Clark); San Pablo Dam, Orinda, Contra Costa Co., one volant on *Lophortyx c. californica,* Oct. 13 (I.B. Tarshis) and one volant on *Accipiter striatus velox,* Nov. 3 (A. Hightower); Pinecrest, Tuolumne Co. (P.H. Arnaud); hills back of Oakland, Alameda Co. (J.E. Gillaspy); Strawberry Canyon, Berkeley, Alameda Co. (J.W. MacSwain); Sierral, Alameda Co., one volant on *Bubo virginianus pacificus* (I.B. Tarshis); Tildon Park, Berkeley, Alameda Co., on *O. h. columbianus* (I.B. Tarshis); Miami, Mariposa Co., on *O. h. hemionus* (Cope); Yosemite National Park, 3880–4000 ft., on *O. h. hemionus* (R.H. Smith); Big Trees Park, Santa Cruz, Sa. Cruz Co. (S.J. Carpenter and A.F. Archer); Ben Lomond, Sa. Cruz Co. (P.H. Arnaud); Felton, Sa. Cruz Co. (E.I. Schlinger); Del Monte Forest, 1½ miles S. of Pacific Grove, Monterey Co. (A.F. Archer); Arroyo Seco River, Monterey Co. (L.W. Hepner); Hastings Reservation near Jamesburg, Monterey Co., on *O. h. hemionus* (J.M. Linsdale); Carmel, Monterey Co. (N.E. Good); Pinnacles National Monument, San Benito Co. (J.W. MacSwain); Hollister, San Benito Co. (E.I. Schlinger); Dinkey Creek, Fresno Co. (C.K. Fisher); Huntington Lake, Fresno Co. (A.T. McClay); Florence Lake, Fresno Co., 7500 ft (E.I. Schlinger);

Hospital Rock and Ash Mt., Sequoia National Park, Tulare Co. (P. Oman; R.C. Bechtel; A.T. McClay); Big Pine Creek, Inyo Co. (R.M. Bohart); Kern Co. (E.A. McGregor); Santa Maria Valley, Sa. Barbara Co. (D.J. and I.N. Krull); Altadena, Los Angeles Co. (K.W. Cooper); Mt. Wilson Trail near Pasadena, Los Angeles Co. (K.W. Cooper; W.A. McDonald); Griffith Park, Los Angeles; Lake Elizabeth Canyon, Los Angeles Co. (J.N. Belkin); Westwood Hills, Los Angeles Co. (J.N. Belkin); Arcadia, Los Angeles Co. (K.W. Cooper); Tanbark Flat, Los Angeles Co. (F.X. Williams; J.K. Hester); Glendale, Los Angeles Co. (E.I. Schlinger); Big Dalton Dam, Los Angeles Co. (A.A. Grigarick); Sa. Catalina Is., Los Angeles Co. (W.J. Jellison and Welsh); Camp Baldy, San Bernardino Co. (A.T. McClay); Forest Home, San Bernardino Co., volants, Apr. 23 (V.E. Grant and R.K. Benjamin); Fullerton, Orange Co. (J.W. Hinerman); Marion Mtn. Camp, San Jacinto Mts., Riverside Co. (W.V. Garner); Keen Camp, Riverside Co. (E.I. Schlinger); Glen Ivy Hot Spring, Riverside Co.; Idyllwild, San Jacinto Mts., Riverside Co. (R. Husbands); Cabazon, Riverside Co., on *O. h. californicus* (D.G. Hall); Cleveland National Forest, San Diego Co., on *O. h. californicus* (H. Owen); Banner, San Diego Co. (W.W. Wirth); Escondido, San Diego Co. (G.S. Hull); [recorded in 1942 also from Trinity, Lassen, Calaveras, San Luis Obispo, and Ventura Counties]. — Idaho (recorded by J. Bequaert, 1942): Coeur d'Alene National Forest, Shoshone Co., on *O. v. leucurus* (O. Callis); Moscow Mt., Latah Co. (F.C. Zwickel); Laird Park, 8 miles from Harvard, Latah Co., volant, Oct. 3 (L. Yates). — Montana (recorded by J. Bequaert, 1942; Steinhaus, 1943): White Sulphur Springs, Meagher Co., on *O. h. hemionus* (C.B. Philip); Lincoln Co., on *O. v. leucurus* (L. Adams); U.S. Bison Range, Moiese, Lake Co., on *O. v. leucurus;* Florence, Ravalli Co. (F.C. Bishopp); Lolo, Missoula Co. (F.C. Bishopp); Lincoln, Lewis and Clark Co., on *O. v. leucurus*, Nov. (C.B. Philip); Missoula Co., on *O. v. leucurus* (Tibbs; T. Smith); Shook Mt., 6500 ft., Ravalli Co., volant on Man, Oct. 25 (Betty Locker). — Oregon (recorded by Shaw, Simms, and Muth, 1934; J. Bequaert, 1942; Shaw, 1947): Corvallis, Benton Co., on *O. h. columbianus* (A.W. Lindquist and E.F. Knipling); Diamond Lake, Douglas Co. (V. Roth); 10 miles N.W. of Baker, Baker Co. (V. Roth); Curlew, Ferry Co., Oct. 25 (H.I. Buechner); Cottonwood Canyon, Blue Mts., Asotin Co., on *O. h. hemionus,* Oct. 25 (H.K. Buechner); Devils Ridge, Blue Mts., Asotin Co., Oct. 17. — South Dakota (recorded by J. Bequaert, 1942): 2 miles W. of

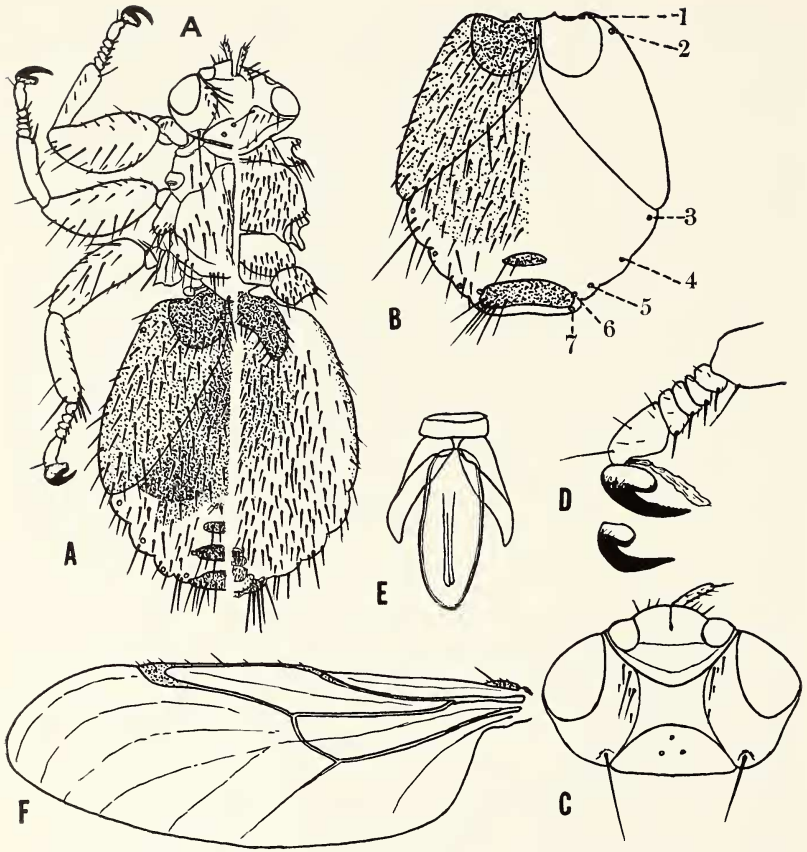

Fig. 100. *Lipoptena depressa* (Say). **A**, body dorsally and ventrally, ♀, Palomar Mountain, California, on *Odocoileus hemionus californicus;* **B**, abdomen dorsally and ventrally, ♂, Howe Sound, British Columbia, on *O. h. hemionus;* abdominal spiracles numbered 1 to 7; **C**, head, ♀, Palomar Mountain; **D**, tarsus and claws (inner and outer) of fore leg, ♀, same data; **E**, ♂ terminalia from above; **F**, wing of volant ♂, Sequoia National Park, California.

Rapid City, Pennington Co., June 17, on *O. h. hemionus* (L.M. Berner); Hot Springs, Fall River Co., on *O. v. leucurus* (H.C. Severin); Sylvan Lake, northern part of Custer Co., on *O. v. leucurus* (H.C. Severin); Spearfish, Lawrence Co., on *O. h. hemionus*, Nov. 10 (P. Kohler). — WASHINGTON (STATE) (recorded by Hatch, 1938; J. Bequaert, 1942): Spokane, Spokane Co. (D.E. Hardy); Mt. Constitution, Olga I., Puget Sound (A.C. Brown); Pullman, Whitman Co., volant, Sept. 17 (Helen James); Matlock,

Mason Co.; Ruby, Pend Oreille Co., on *O. v. leucurus;* Addy, Stevens Co., on *O. h. hemionus* (J. Hatter); Colville, Stevens Co. (C.O. Chollet). — WYOMING: Greybull, Big Horn Co., on *O. h. hemionus* (W.V. Cochran).

L. depressa is restricted to western North America, where it is known at present along the Pacific Coast from southern British Columbia (south of 50° N.) to southern California (San Diego Co., about 33° N.) and as far inland as the Black Hills of western South Dakota (about 103° 30′ W.). It occurs no doubt also in some of the Rocky Mountain states and provinces not listed above. It should be looked for particularly in Colorado, where no deer-keds have been recorded, although this is the area where Say most probably collected the type specimens.

Deer-keds seem to be absent from Arizona and New Mexico, although deer are fairly common there in certain sections. According to Dr. A.R. Mead (*in litt.*, 1953), Mr. Paul Illig examined some 300 deer in the area north of Phoenix, but failed to find any keds, although he is well acquainted with these parasites. The matter should be investigated further, as some adverse climatic factor may be involved.

Bionomics. *L. depressa* is the usual and common parasite of several races of *Odocoileus hemionus*, the Rocky Mountain mule deer, *O. h. hemionus*, the coastal black-tailed deer, *O. h. columbianus*, the California black-tailed deer, *O. h. californicus*, and probably also the southern black-tailed deer, *O. h. fuliginatus* (volants taken in San Diego Co.); as well as of the western white-tailed deer, *Odocoileus virginianus leucurus*. Both species are equally efficient breeding hosts. There is one stray record from American elk or wapiti, *Cervus canadensis*. The volants, or newly-emerged winged keds, often appear in large numbers at the proper season, particularly in spring and fall, and fly onto any moving object, thus reaching Man and horses on which they alight for a short time, but scarcely ever attempt to feed. Most of the records listed above without hosts are based on such volants. The winged keds may also stray to wild birds, which explains the accidental occurrences on California valley quail, great horned owl, sharp-shinned hawk, and pygmy nuthatch.

In my 1942 Monograph (pp. 123–124) I discussed the bionomics of *L. depressa* and in Part I of the present work I mentioned briefly the following items: bacteria in the gut (pp. 101 and 132), resistance to starvation (pp. 114–115), distribution on the host's body (p. 125), tropisms (p. 128), sex ratio (p. 177), mating (pp.

181–182), larviposition (p. 186), formation of puparium (p. 196), duration of pupal development (p. 198), adult longevity (p. 203), rate of reproduction (p. 207), population dynamics (p. 228), and host relations (p. 317). Particular attention is now called to two important recent publications by Hare (1953) and by Linsdale and Tomich (1953). Hare followed adult keds on deer in captivity from the volant stage throughout life. Linsdale and Tomich studied the population dynamics and behavior of the keds in the Hastings Reservation, Monterey Co., California, a natural undisturbed area well stocked with black-tailed deer, which often showed mixed infestations of *L. depressa* and *N. ferrisi* (see under that species). Of 6,582 keds taken on 25 deer in 8 different months, 5,619, or 85.4 per cent, were *depressa*. This species occurred on the host in all 8 months, but mostly in July (849), August (986) and September (the peak month, with 3,437 keds). The keds were few in January (13), May (9), October (64), November (4) and December (204). The largest individual infestation consisting only of *L. depressa* numbered 64, and the heaviest of both *L. depressa* and *N. ferrisi* was on a buck carrying 3,493 keds. The authors also made many observations on the volants in the same area: few flies were on the wing through the winter; they became more abundant in April and May and were at their peak in August, September and October. In late fall they were particularly numerous in periods of warm weather. Although many were observed alighting on Man or horse, they were rarely seen attempting to bite a horse and never established themselves on this host. Most of the volants left quickly without dropping the wings. The authors note that the flies are apparently unable to survive or to transfer to a new host after losing the wings or in cold weather.

The puparium, figured by Hearle (1938) and Herman (1945, as *N. ferrisi*), was described in my Monograph (1942*a*, p. 124).

Say's original description of *Melophagus depressus* was copied in my Monograph (1942*a*, p. 124). I have attempted to define more precisely the section of Colorado where Say obtained his specimens. E. James' "*Account of the Expedition from Pittsburgh to the Rocky Mountains . . . under the Command of Major Stephen H. Long*" (2 Vols., Philadelphia, 1823) shows that deer were common and frequently killed by the party in the area of the Upper Arkansas River between the 102nd Meridian and Pike's Peak (near 105° W.). In Vol. 2 there are frequent references (pp. 34, 40, 49, 63, 70, 75, 84, and 88) to western white-tailed deer, now called *Odocoileus virginianus leucurus*, and black-tailed or mule

deer, now called *O. h. hemionus*. Say described the latter anew as *Cervus macrotis* (Vol. 2, p. 88, footnote) from a skin obtained in this area. As *L. depressa* is found on both kinds, he had plenty of opportunity to collect it. This ked should therefore be looked for in southeastern Colorado, preferably in El Paso and Pueblo Counties, on whatever deer may remain there.

Lipoptena (*Lipoptenella*) *mazamae* Rondani
Figs. 101*A–D*

The following references are mostly supplementary to my 1942 Monograph.

Lipoptena mazamae Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 153 (♀. Central and South America, without precise locality; on "*Cervus mexicanus*" [=*Odocoileus virginianus mexicanus*]. Type collected by Bellardi, hence it came most probably from Mexico; presumably lost). Vogelsang, 1940, Rev. Med. Veter. Paras., Caracas, **2**, Nos. 3–4, p. 37 (Venezuela: Barbula, State Carabobo, on cattle). J. Bequaert, 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 80. Van Volkenberg and Nicholson, 1943, Jl. Wildlife Manag., **7**, p. 222 (Texas: Comal Co., on deer). Guimarães, 1944, Papéis Avulsos Depto. Zool., São Paulo, **6**, No. 16, p. 184, figs. 3, 3*a*, 4 (Brazil: Porto Cabral, State São Paulo, on *Mazama americana*. Puparium). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Reyes, 1947, Rev. Grancolombiana Zoot. Hig. Med. Vet., Caracas, **1**, Nos. 10–12, p. 707 (Colombia: Rio Negro, Santander, on deer); 1948, Rev. Med. Vet., Bogotá, **17**, No. 96, p. 71. Vogelsang, 1948, Rev. Med. Veter. Paras., Caracas, **7**, Nos. 1–4, p. 146. Eads, 1949, Jl. Econ. Entom., **42**, p. 158 (Texas: New Braunfels, on cattle). Renjifo-Salcedo, 1950, An. Soc. Biol., Bogotá, **4**, pt. 1, p. 5 (Colombia). de Buen, 1950, An. Inst. Biología, México, **21**, pt. 2, p. 245 (Mexico: Majahuita, 1 Kilom. W. of Zihuatanejo, State Guerrero, on "*Odocoileus virginianus acapulcensis*" [=*O. v. mexicanus*]). Gallo and Vogelsang, 1951, Rev. Veter. Paras., Caracas, **10**, Nos. 1–4, p. 35 (Venezuela: on *Odocoileus* and cattle). Hennig, 1952, Larvenformen der Dipteren, **3**, p. 403.

Lipoptena (*Lipoptenella*) *mazamae* J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 126, figs. 12*A–C* (with detailed bibliography and locality records); 1943, Jl. of Parasitology, **25**, p. 131.

Lipoptena mazani Vogelsang, 1953, Deutsch. Tierärztl. Wochenschr., **60**, p. 530 (Venezuela: on cattle in the Llanos; error for *mazamae*).

Lipoptena depressa var. *mexicana* Townsend, 1897, Ann. Mag. Nat. Hist., (6), **20**, p. 289 (♀ ♂. Mexico: Paso de Telaya, State Vera Cruz, on *Odocoileus virginianus mexicanus*. Cotypes at Brit. Mus.). Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Lipoptena conifera Speiser, 1905, Zeitschr. Syst. Hym. Dipt., **5**, p. 354 (♀ ♂. Brazil: on *Mazama simplicicornis*. Types probably lost); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Lipoptena surinamensis Bau, 1930, Stettin. Ent. Zeitg., **91**, pt. 2, p. 175 (♀ ♂; no host. Surinam: Paramaribo [misspelled "Macaraibo"]. Types formerly at Hamburg Mus., now lost; paratypes at Stanford Univ. Mus.).

Lipoptena cervi Fiasson, 1943, Rev. Sci. Méd. Pharm. Vétér. Afrique Française Libre, **2**, p. 148 (Venezuela: Upper Apure region, on *Odocoileus virginianus gymnotis*); 1945, Cahiers de l'Institut Français Amér. Latine, Mexico, **3**, p. 26 (Venezuela: Upper Apure region, on

Odocoileus virginianus gymnotis. I have seen some of these specimens). Corrêa, 1952, Bol. Dir. Prod. Anim., Rio Grande do Sul, **8**, No. 13, p. 3; Pl., fig. 1 (Brazil: São-José-del-Norte, State Rio Grande do Sul, on "veado comun"). Not of Linnaeus, 1758.

Melophagus ovinus Randolph and Eads, 1947, Ann. Ent. Soc. America, **39**, (for 1946), pt. 4, p. 600 (Texas: Lavaca Co., on *Odocoileus v. virginianus*). Not of Linnaeus, 1758.

Distribution and Additional Records (since 1942). UNITED STATES. FLORIDA (recorded by J. Bequaert, 1942): Seminole Indian Reservation, Hendry Co., on *Odocoileus virginianus osceola*, Dec. 6, 1942 (H.S. Peters; W.R. Baldwin); 3 miles S. of Cox Lake, Collier Co., on *O. v. virginianus*, Nov. 21, 1936 (T.W. Cole). — GEORGIA (recorded by J. Bequaert, 1942): Camp Stewart, near Clyde, Bryan Co., on *O. v. virginianus* (R.H. McCauley, Jr.); Blackbeard I. Wild Life Refuge, McIntosh Co., on *O. v. virginianus* (E.A. Goldman; J.O. Harrison). — LOUISIANA: Madison Parish; Tensas Parish; Catahula Parish; Ouachita Parish; Union Parish; and Morehouse Parish; December, 1948 and 1951, all on *O. v. virginianus* (Louisiana State Board of Health; received through E.B. Johnson). — SOUTH CAROLINA: (recorded by J. Bequaert, 1942): Summerville, Dorchester Co., Oct. 8 (F.C. Bishopp). — TEXAS (recorded by J. Bequaert, 1942; Van Volkenberg and Nicholson, 1943; Randolph and Eads, 1947, as *M. ovinus;* Eads, 1949): Camp Bullis near San Antonio, Bexar Co., on *O. v. virginianus* (J.M. Brennan; T. McGregor); Lavaca Co., on *O. v. virginianus* (N.M. Randolph and R.B. Eads); Kleberg Co., on *Tayassu a. angulatus* (W.B. Davis. — Texas St. Dept. of Health); Kendall Co., on *O. v. virginianus* (A.C. Riba. — Texas St. Dept. Health); New Braunfels, Comal Co. (W.S. Ross) and 2 deälated specimens from a cow (H.J. Reinhard. — Texas St. Dept. Health); Leon Springs, 10 miles N. W. of San Antonio, Bexar Co., on *O. v. virginianus* (H.R. Roberts); Nixon, Gonzales Co.; Bandera, Bandera Co., on *O. v. virginianus* (H.E. Parish); Kimble Co. on *O. v. virginianus* (S.S. Bundy); Center Point, Kerr Co. on *O. v. virginianus* (H.E. Parish); Colorado Co.; Edwards Co., on *O. v. virginianus* (F.C. Bishopp); Gonzales, Gonzales Co., on *O. v. virginianus* (J.A. Deere).

MEXICO (recorded by Rondani, 1878; Townsend, 1897, as *L. depressa* var. *mexicana;* Austen, 1903, as *Lipoptena* sp.; J. Bequaert, 1942; de Buen, 1950): Apatzingan, State Michoacan, on *O. virginianus mexicanus* (R. Traub); State Chiapas (Esc. Nac.-Cienc.Biol.); San Rafael, State Vera Cruz, 4 specimens labelled *L. depressa* var. *mexicana,* collected by Townsend; [one ♀ labelled "cotype" by Brunetti]. — Brit.Mus.); Majahuita, 1 Kilom. W. of

Zihuatanejo, State Guerrero, on *O. virginianus mexicanus* [= *O. v. acapulcensis*] (Mrs. Ana María de Buen de Biagi).

Guatemala (recorded by J. Bequaert, 1942).

Republic of Honduras (recorded by J. Bequaert, 1942).

Panama (recorded by Ferris, 1930; J. Bequaert, 1942): Panama City (J.G. Sanders).

Colombia (recorded by Reyes, 1947, 1948; Renjifo-Salcedo, 1950): Municipio Río Negro, Dept. Santander, on deer (L.M. Murillo); Río Cesar, Valledupar, Dept. Magdalena, on *Mazama simplicicornis;* Río Mecaya, Dept. Caqueta, on *Mazama americana* (P. Hershkovitz); San-Juan-Nepomuceno, Dept. Bolivar, on *Mazama simplicicornis nemorivaga* (P. Hershkovitz).

Venezuela (recorded by Vogelsang, 1940, 1951, 1953; J. Bequaert, 1942; Fiasson, 1943, 1945, as *L. cervi;* Gallo and Vogelsang, 1951): Yagua, State Cojedes (H.A. Beatty); San Fernando, Apure River, State Apure, on *O. virginianus gymnotis* (R. Fiasson).

Trinidad (recorded by J. Bequaert, 1942): Heights of Aripa, on deer (M.A. Carriker, Jr.); Cumaca, on *Mazama rufa* (T.H.G. Aitken).

British Guiana (recorded by J. Bequaert, 1942).

Dutch Guiana (recorded by Bau, 1930, as *L. surinamensis;* J. Bequaert, 1942).

French Guiana: Oyapock, on "cariacu," *Mazama* sp. (H. Floch).

Brazil (recorded by Speiser, 1905, as *L. conifera;* J. Bequaert, 1942; Guimarães, 1944; Corrêa, 1952): Nova Teutonia near Itá, State Sa. Catharina, on *Mazama tema* and *M. americana* (F. Plaumann); Salobra, State Matto Grosso (Inst.Osw.Cruz).

Ecuador (recorded by J. Bequaert, 1942).

Peru: Pan de Azucar, Río Tarma, 1400 m., on "samaño," a small deer with very short legs (W. Weyrauch); Tingo María, 700 m., Río Huallaga, on *Mazama* sp. (W. Weyrauch).

Bolivia (recorded by Ferris and Cole, 1922; Bau, 1930; J. Bequaert, 1942).

Paraguay (recorded by J. Bequaert, 1942).

Uruguay (recorded by Calzada, 1939, as *L. cervi;* J. Bequaert, 1942).

Argentina (recorded by Falcoz, 1930).

L. mazamae is a common Neotropical deer-ked found in Mexico, Central and South America wherever the normal hosts, deer and brocket, occur. The southmost known occurrence is in the Chaco

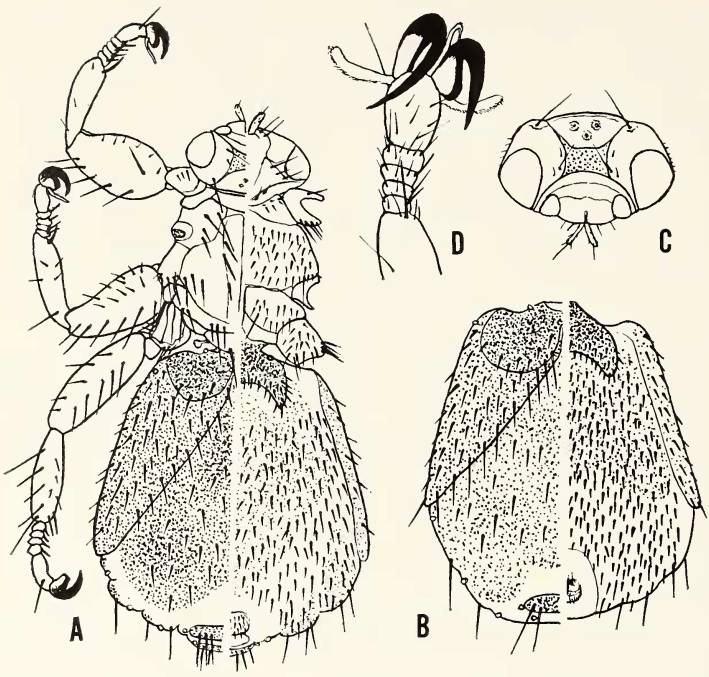

Fig. 101. *Lipoptena mazamae* Rondani. **A**, body dorsally and ventrally, ♀, Manaos, Brazil; **B**, abdomen dorsally and ventrally, ♂, Camp Pital, Panama, on *Mazama tema reperticia;* **C**, head, ♂, same data; **D**, tarsus and claws of mid leg, ♂, same data.

de Santiago del Estero, Argentina (27° 30′ S.). It extends northeastward beyond the Mexican border in the states bordering the Gulf of Mexico and along the Atlantic Coast as far as South Carolina (approximately to 33° 30′ N.). The area it occupies in the United States corresponds roughly to the Austroriparian Division of Merriam's Lower Austral Life Zone. It has not been taken as yet in Mississippi, Alabama, Arkansas and Tennessee. This may be due in part to lack of interested collectors, but, possibly also to the present scarcity or even absence of deer. *L. mazamae* may be expected to occur in Arkansas, however. Mr. E.B. Johnson pointed out to me (*in litt.*) that Union and Morehouse Parishes, Louisiana, where deer-keds have been taken, adjoin the southern boundary of Arkansas, and that three keds were found on deer less than 4 miles from the Arkansas line.

In the southeastern United States, the distribution of *L. mazamae* is sporadic and, when present, it does not seem to occur

in large numbers. Usually only a few deer in a given area carry keds or the parasite may be absent from certain sections within the general distributional area, even when deer are present. Most probably this is due to adverse climatic conditions, particularly the more severe winters recurring at irregular intervals in the southern United States, no section of which is without frost for many successive years. During the unusually severe winter of 1950–1951, Mr. E.B. Johnson, Entomologist of the Louisiana State Board of Health, searched 55 deer from 12 Louisiana parishes without finding a single ked. There had been some days with below-freezing temperatures even on the Gulf Coast from early November on, that is before the deer hunting season opened. A few keds had been taken some years earlier in December from a deer in Madison Parish. During the next winter (1951–1952), however, keds were found on deer in six parishes, all in the northern half of the state. *L. mazamae* is essentially a tropical insect, which struggles to maintain itself in the southeastern United States by taking advantage of the hot and humid summers. It is one of several similar Neotropical elements in the southeastern section of the Nearctic Region.

Bionomics. Throughout its range, *L. mazamae* is a normal parasite of all species and subspecies of deer (*Odocoileus*) and brocket (*Mazama*). Thus far, there are precise records from the following hosts: *Odocoileus v. virginianus* Boddaert, *O. virginianus osceola* (Bangs), *O. v. mexicanus* (Gmelin) (= *O. v. toltecus* de Saussure; *O. v. acalpulcensis* Caton), *O. v. gymnotis* (Wiegmann), *O. v. rothschildi* (Thomas), *Mazama t. tema* Rafinesque, *M. t. reperticia* Goldman, *M. s. simplicicornis* (Illiger), *M. simplicicornis nemorivaga* (Cuvier), and *M. americana* (Erxleben). There are now three records of *L. mazamae* occurring accidentally on domestic cattle (in Venezuela, Georgia and Texas). Other recorded stray hosts are the grison (*Tayra barbara* Linnaeus) and the pecari (*Tayassu a. angulatus* Cope). Guimarães (1944) described and figured the puparium, which is similar to that of *L. depressa;* but very little is known otherwise of the life-history and behavior.

My monograph (1942*a*) contains copies or translations of the original descriptions of *Lipoptena mazamae* and of its three synonyms.

The types of *L. depressa* var. *mexicana* Townsend are not lost, as I supposed (1942*a*, p. 132). This form was originally based on 153 cotypes. At least 4 of these were sent to the late E. Brunetti, in England, and were eventually acquired by the British Museum,

where I saw them in 1951. Both sexes are present in this lot; but only a female was labelled "cotype" by Brunetti; all are labelled "San Rafael, Vera Cruz," a locality only a few miles from Paso de Telaya (20° 20′ N., 96° 50′ W.), given by Townsend. The 4 specimens agree in every respect with what I have been calling *L. mazamae*. The present whereabouts of the other cotypes is unknown; but some of them will probably turn up eventually in other collections.

The statement referring to the type of *Lipoptena mazamae* Rondani (1942*a*, p. 131) also needs correction. Speiser (1904*a*, p. 334) never saw Rondani's type. He merely concluded from a study of the descriptions of *L. depressa* (Say) and *L. mazamae* that both were the same species. Ferris and Cole (1922, p. 185) pointed out that this was an error and gave the first recognizable description and figures of *mazamae*. I have not been able to trace Rondani's type; it could not be found at the Genoa Museum, in Bellardi's collection at the University Zoological Museum in Turin, or in Rondani's personal collection now at the Museum in Florence; most probably it is lost permanently.

Lipoptena (Lipoptenella) guimaraesi, new species
Figs. 102*A–D*

Female. Head (Fig. 102*C*) moderately lengthened behind the eyes, seen in front nearly elliptical, about $1\frac{2}{5}$ times as wide as high; mediovertex short and wide, a little less than half the length of frons as well as of postvertex; a very weak interantennal suture and a more pronounced suture setting off a preptilinal area; inner orbit narrower than eye, bearing 3 long bristles and a shorter one closer to the antenna; one very long vertical bristle; postvertex long and broad, about as long as frons, longer than in *L. depressa* and *L. mazamae;* ocelli distinct, in a nearly equilateral triangle. Palpi slightly shorter than frons. Thorax (Fig. 102*A*) dorsally: pro-mesonotal suture well marked; median notal suture very weak or lacking; transverse mesonotal suture present, broadly interrupted medially; traces of longitudinal intrascutal grooves; posthumeral suture weak, but complete; prothoracic spiracle large, at latero-posterior edge of humeral callosity; 5 acrostichals in a curved row; 5 or 6 latero-centrals, forming a transverse group connecting the posterior acrostichals with the preälar group of mesopleurals; 4 or 5 humerals; 5 or 6 prescutellars; 3 long and a few shorter mesopleurals at apex of anepisternum; 2 scutellars (1 median pair). Thorax ventrally: lobes of prosternum with 6 or 7

long and short, stout setae; basisternum of mesothorax and of metathorax mostly covered with spaced, short, stiff setae, in irregular transverse rows; furcasternum of metathorax bare. Abdomen (Fig. 102*A*) dorsally: basal dorsal pleurite (laterotergite I) large, wider than long, fairly well set off from the 2nd dorsal pleurite (laterotergite II) in older, fully sclerotized specimens, with an apical row of setae; laterotergite II well sclerotized in older specimens, very long, elongate triangular with the inner side slanting toward the basal median notch between the 2 laterotergites I, uniformly covered with spaced, stiff, moderately long setae; only 2 median tergal, smooth, sclerotized plates close to the tip of the abdomen (as in *L. mazamae*), corresponding to the 4th and 5th preäpical sclerites of some other species of *Lipoptena*, as shown by the position of the 6th and 7th spiracles; 4th sclerite a continuous, transverse, semi-elliptical plate, broader than in *L. depressa*, with a transverse preäpical row of 6 long setae (3 on each side); 5th sclerite narrowly divided in the middle, much smaller than the 4th, each half with 3 long setae; in addition to these well-defined sclerites, a very small area, bearing a median pair of setae, is set off by a slight, curved groove immediately before the 4th sclerite; but this area is membranous, dull and with the same alutaceous sculpture as the surrounding dorsum. Sixth abdominal spiracle outside the 4th sclerite, but close to its outer hind edge; 7th at the outer edge of the 5th sclerite or somewhat within it. Median area of dorsum, outside the basal laterotergites and the smooth apical sclerites, membranous or more or less sclerotized, dull, coarsely alutaceous, and fairly uniformly covered with spaced, stiff, moderately long setae. Abdomen ventrally: basal, strongly sclerotized, ventral sclerite deeply emarginate, crescent-shaped as in *L. mazamae*, the side lobes bluntly triangular, with a few heavy setae in a marginal row and over posterior half; venter otherwise membranous and uniformly covered with spaced, moderately long setae, about as in *L. depressa*. Legs thick, moderately setose, as in *L. mazamae;* apical spur of fore tibia stout, spine-like; mid tibia with 3 apical spurs (Fig. 102*D*), the middle one very long, the 2 outer ones much shorter; claws nearly symmetrical in a pair. Wing unknown.

Male. Similar to the female in structure and chaetotaxy. Abdomen (Fig. 102*B*) with only one median dorsal smooth plate at apex, corresponding to the 4th of the female, as shown by the position of the 6th spiracle close to its outer edge (as in *L. mazamae*); the sclerite with a group of 3 long setae in each corner; a

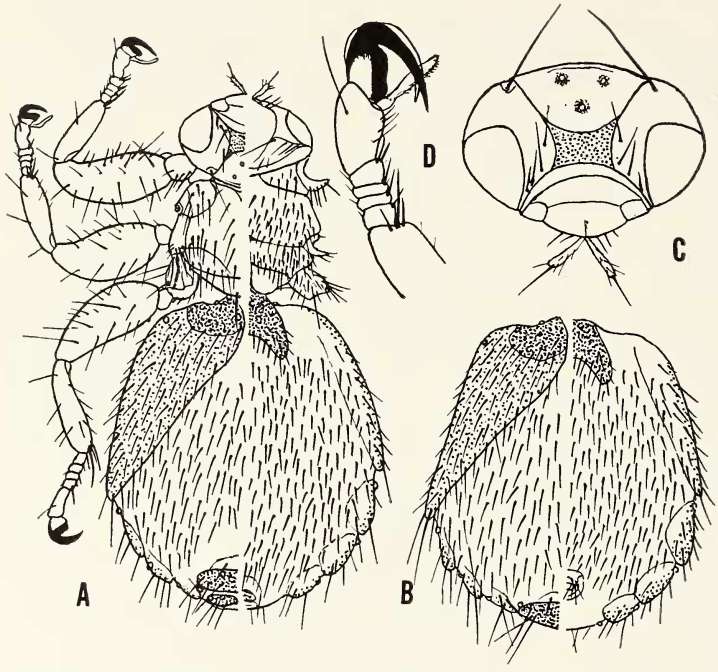

Fig. 102. *Lipoptena guimarãesi* J. Bequaert. **A**, body dorsally and ventrally, ♀ holotype, Rio das Mortes, Brazil, on *Ozotoceros bezoarticus;* **B**, abdomen dorsally and ventrally, ♂ allotype, same data; **C**, head, ♀ holotype, same data; **D**, tarsus and claws of mid leg, ♀, same data.

superficially defined, not sclerotized, dull, alutaceous area, bearing a median pair of setae, basad of the 4th sclerite, as in the female.

Length (head + thorax): ♀, 1.6 to 1.7 mm.; ♂, 1.4 to 1.5 mm.; total length of fed, fully sclerotized, deälated specimens preserved in alcohol, up to about 4.3 mm. in ♀, 3.5 mm. in ♂.

Brazil. Rio das Mortes, San Domingo, State Matto Grosso, ♀ holotype, ♂ allotype, and 1 ♀, 1 ♂ paratypes, on pampas deer, *Ozotoceros bezoarticus;* Rio das Mortes, Pindaiba, State Matto Grosso, 1 ♀ paratype, on *Ozotoceros bezoarticus;* Corrego da Saudade, State Goyaz, 1 ♀, 1 ♂ paratypes, on *Ozotoceros bezoarticus.* Also 8 ♂, 2 ♀ and 7 newly hatched, deälated, unfed specimens of doubtful sex, without locality or host data, but from Brazil. All specimens preserved in alcohol and received from the Departamento de Zoologia of the State of São Paulo, where holotype, allotype and most paratypes are deposited; a few paratypes at the Mus.Comp.Zool., Cambridge, Mass. (No. 29559).

L. guimaraesi combines some of the characters of *L. depressa* and of *L. mazamae*, as may be gathered from the key. It differs from either in the number of apical spurs of the mid tibia and in the longer postvertex. The chaetotaxy of head and mesonotum are more like that of *L. depressa;* but it has the stout spur of the fore tibia and the reduced median dorsal sclerites of *L. mazamae.*

This species is known only from the pampas deer, *Ozotoceros bezoarticus*, a member of the family Cervidae in the order Artiodactyla, with a present-day limited distribution from Bolivia and southern Brazil to northern Patagonia. Presumably it is a specific parasite of this host.

Melophagus Latreille, 1802

Melophagus Latreille, 1802 (An X), Hist. Nat. Crust. Ins., **3**, p. 466 (monotypic for *Hippobosca ovina* Linnaeus, 1758). J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 157 (full synonymy).

A detailed generic description is given in my Monograph (1942*a*), where I divide the genus into two subgenera, both monotypic: *Melophagus*, proper, (for *M. ovinus*), and *Dorcadophagus* (for *M. rupicaprinus* Rondani). It was originally restricted to the Palearctic Region of the Old World. *M. ovinus*, the sheep-ked, has been widely distributed by Man with its host and in this manner reached the New World since Columbus' time.

Melophagus ovinus (Linnaeus)

Figs. 15, 16*A–D*, 17*A–C*, 18*D*, 103*A–D*, and 104*A–G*

Hippobosca ovina Linnaeus, 1758, Syst. Nat., 10th Ed., **1**, p. 607 (no sex; "*inter ovium lanam,*" without locality; saw specimens from southern Sweden. Type lost). Ramdohr, 1809, Abbildungen Anatomie Insecten, p. 22; Pl. 21, fig. 6; 1811, Abhandlung über die Verdauungswerkzeuge der Insecten, p. 185; Pl. 21, fig. 6 (digestive system).

Hippobosca ovis Hicks, 1860, Trans. Linn. Soc. London, **23**, pt. 1, p. 140; Pl. 18, fig. C2 (sensory organs on legs).

Melophagus ovinus montanus Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 192, figs. 9*E* and 10 (♂. Alaska-Yukon Boundary, on either *Ovis dalli* or *Ovis canadensis.* Types at Stanford Univ. Mus., Palo Alto). Essig, 1926, Insects Western North America, p. 621.

Melophagus ovinus form *bolivianus* Bau, 1930, Stettin. Ent. Zeitg., **91**, pt. 2, p. 176 (♀ ♂; no host. Oruro, Bolivia. Types formerly at Hamburg Mus., now lost; paratypes at Stanford Univ. Mus., Palo Alto).

The following references, mainly to American publications, supplement those of my Monograph (1942*a*).

Melophagus ovinus Lintner, 1882, **1st** Ann. Rept. Injurious Other Insects New York, p. 62. Howard, 1883, South Carolina, Resources and Population, p. 275. Stiles and Hassall, 1893, U.S. Dept. Agric., Bur. Anim. Ind., Bull. **4**, p. 87. J.B. Smith, 1894, Rept. New Jersey Agric. Coll. Expt. Sta., (for 1893), p. 511, fig. 50. Kellogg, 1905, American Insects,

p. 351, fig. 502 (also in 2nd Ed., 1908). Daniels and Stanton, 1907, Studies in Laboratory Work, 2nd Ed., pp. 192 and 193, fig. 94. Haimbach, 1907, Ent. News, **18**, p. 208 (Pennsylvania: Philadelphia). Kaupp, 1908, Animal Parasites Parasitic Diseases, p. 25, figs. 2–3. Torreggiani, 1909, Bol. Min. Col. Agric. Bolivia, **5**, pp. 68 and 69 (Bolivia). Wolffhügel, 1911, Revista Centro Estudiantes Agronomia Veterinaria, Buenos Aires, **3**, (for 1910), Nos. 24–26 (reprint: Buenos Aires, 1911, pp. 10 and 13; in Argentina); 1912, Rev. Medic. Veter. Esc. Montevideo, **2**, (for 1911), Nos. 10–11, p. 462 (Argentina: Prov. Córdoba. Biting Man). Hall, 1912, Colorado College Publ., Science Ser., **12**, No. 10, p. 360 (Colorado: Fort Collins; Resolis; Amo; Colorado Springs). Herms, 1913, California Cultivator, 41, p. 290. Torreggiani, 1914, Nuovo Ercolani, **19**, p. 421 (Bolivia). Herms, 1915, Medical Veterinary Entomology, p. 294, fig. 185 (adult, puparium). Lutz, 1918, Field Book Insects, pp. 277 and 279; Pl. 71, fig. Linton, 1921, Veterinary Hygiene, p. 349. Sanderson, 1921, Insect Pests Farm Garden Orchard, 2nd Ed., (by L.M. Peairs), p. 669, fig. 589. Hoffman, 1922, Rept. New York State Vet. Coll., Cornell Univ., (for 1920–1921), p. 201. Craig, 1923, in Wooldridge, Encyclopaedia Veterinary Medicine, **1**, Veter. Med., p. 500. Herms, 1923, Medical Veterinary Entomology, 2nd Ed., p. 349, fig. 186. J.H. Comstock, 1924, Introduction to Entomology, p. 874, fig. 1119 (also in later printings). Fernald, 1926, Applied Entomology, 2nd Ed., p. 333, figs. 351 (engorged ♀) and 352 (newly-emerged). Edwards and Shannon, 1927, Rev. Inst. Bacter., Buenos Aires, **4**, No. 7, p. 658 (southern Chile, on sheep). Brittain, 1927, Prov. Nova Scotia Dept. Natural Recources, Bull. No. **12**, p. 106, fig. 43, and p. 157. Metcalf and Flint, 1928, Destructive Useful Insects, p. 803, fig. 540. Hall, 1928, Parásitos Ganado America Latina (Union Panamericana, Agricultura No. **47**), p. 27; 1929, U.S. Dept. Agric., Farmers' Bull. **1330** (revised), p. 5, fig. 4 (also revised in 1932 and 1933). Veintemillas, 1935, El Tifus Exantemático Boliviano o el Tifus Altiplánico, La Paz, p. 90. Babcock and Parish, 1936, Insect Pest Survey Bull., (mimeographed), **16**, No. 4, p. 146 (Texas: on sheep and goat at Sonora, Ozona Junction; on sheep near Menard). Hall, Dikmans, and Wright, 1936, U.S. Dept. Agric., Farmers' Bull. **1330**, (revised), pp. 5–7, fig. (also revised in 1938, 1944 and 1946). Babcock, 1938, **51st** Ann. Rept. Texas Agric. Expt. Sta., pp. 224–225. Brittain and Pickett, 1938, Prov. Nova Scotia Dept. Agric., Ent. Div., Bull. No. **12**, (revised), pt. 2, p. 86, fig. 15, and p. 159. Knowlton, Harmston, and Stains, 1939, Utah Agric. Expt. Sta., Mimeogr. Ser., **200**, pt. 5, p. 19 (occurrence in Utah). Wille, Ocampo, Wederbauer, and Schofield, 1939, Min. Fomento, Dir. Agric. Ganad., Lima, Peru, Bol. No. **16**, (revised Bol. No. **11**, 1937), p. 96 (Peru; control). Babcock, 1940, **52nd** Ann. Rept. Texas Agric. Expt. Sta., (for 1939), p. 246. Mail, 1940, War-Time Prod. Ser., Agric. Suppl. Board, Ottawa, Spec. Pamphl. No. **13**, p. 1 (Canada). Hurtado, 1940, Manual Parasitología Médica, Guatemala, (1938), p. 240. James, 1940, Sheep Breeder, Chicago, **60**, No. 2, pp. 3 and 19. Shull and Fisher, 1940, Univ. Idaho, Ext. Bull. **129**, pp. 51–52. Willman, 1941, Americ. Agric., **138**, p. 291. Horlacher and Hammonds, 1942, Sheep, 2nd Ed., pp. 229–232. Gwatkin, Painter, and Moynihan, 1942, Canadian Jl. Comp. Med. Vet. Sci., **6**, No. 6, p. 163 (Alberta: Whitla District). J. Bequaert, 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 8; 1942, Entomologica Americana, (N.S.), **22**, p. 160, figs. 2*A–C*, 17*A–G*, and 18*A–D* (bibliography). Essig, 1942, College Entomology, pp. 813 and 815, fig. 305. Whitehead, 1942, Macdonald College, Farm Bull. **7**, p. 26; Pl. 3, fig. 6 (Quebec). Imes and Babcock, 1942, U.S. Dept. Agric., Yearbook for

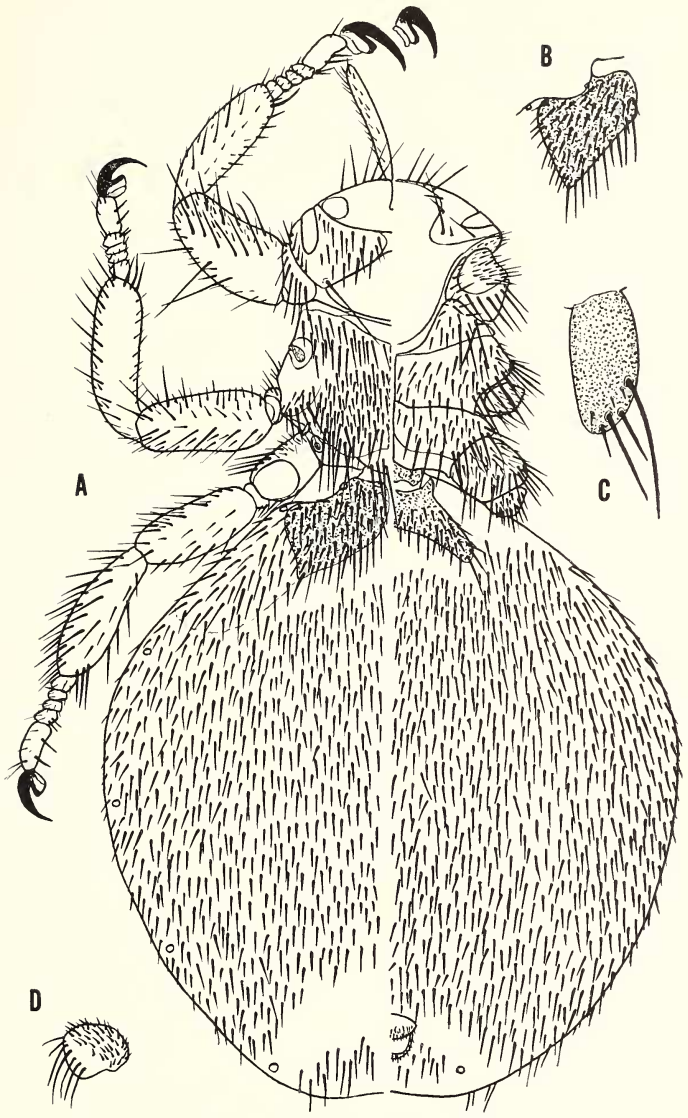

Fig. 103. *Melophagus ovinus* (Linnaeus). **A**, body dorsally and ventrally, ♀, Midland Co., Michigan; **B**, basal laterotergite, ♂, Bogotá, Colombia; **C**, rudiment of wing, ♂, same data; **D**, dorsal aspect of fore coxa, ♂, same data.

1942, "Keeping Livestock Healthy," pp. 912–916, figs. 1*A–B* and 2. Schwardt and Matthysse, 1942, **55th** Rept. New York Agric. Expt. Sta., Cornell, p. 127; 1943, *idem*, **56th** Rept., Cornell, p. 121. Mohler, 1943, U.S. Dept. Agric., Bur. Anim. Ind., Rept. for 1942, pp. 42–43. Day, 1943, Psyche, **50**, pp. 1–8, Pl. (corpus allatum). Marsh, 1943, Montana Wool Grower, **17**, No. 6, p. 11. Smith and Benner, 1943, New Mexico Agric. Expt. Sta., Entom. Circ. **153**, (revised), p. 33. Woodbury, 1943, Amer. Assoc. Adv. Sci., Publ. No. **20**, p. 72 (rearing). Imes and Babcock, 1943, Sheep and Goat Raiser, **24**, p. 18. McIndoo, 1943, U.S. Dept. Agric., Bur. Ent. Plant Quar., **E-597**, (mimeographed), p. 16. R.C. Smith, 1943, Common Insects Kansas, p. 379, fig. 414. Schwardt and Matthysse, 1943, Jl. Econ. Entom., **36**, p. 105. Thomssen and Doner, 1943, Soap, **19**, p. 133. Cobbett and Smith, 1943, Jl. Amer. Vet. Med. Assoc., **103**, p. 6, fig. 1. Snodgrass, 1943, Smithson. Misc. Coll., **104**, No. 1, pp. 44 and 46; figs. 16*B*, *C* and *F*, and 17*B*, *C* and *H* (mouth-parts); 1944, *Op. cit.*, **104**, No. 7, pp. 78, 79, 80, 81; figs. 30*B*, *C* and *F*, and 31*B*, *C* and *H* (mouth-parts). Ackert (*et al.*), 1944, Proc. **47th** Ann. Meet. U.S. Live Stock Sanit. Assoc., (1943), pp. 69 and 72. Cobbett and Smith, 1944, North Amer. Vet., **25**, p. 536; 1944, Wyoming Wool-Grower, **8**, No. 14, pp. 1 and 3–5. Hancock, 1944, Nova Scotia Dept. Agric., Bull. **10**, pp. 53–55. Shull, 1944, Univ. Idaho, Bull. **252**, p. 46. Munro, 1944, Jl. Econ. Entom., **37**, pp. 350–351. Miller, 1944, U.S. Dept. Agric., Bur. Anim. Ind., Rept. for 1943–1944, p. 37. Kemper, 1945, New Mexico Stockman, **10**, No. 1, p. 38, fig. Conn, 1945, Sheep Health, 2nd Ed., pp. 106–107. McEwan and Ewen, 1945, Sci. Practice Canadian Anim. Husbandry, Revised Ed., pp. 329–330. Johnson, 1945, Sheep Breeder, Chicago, **65**, No. 11, p. 6. Gunn, 1945, **39th** Ann. Rept. Dept. Agric. British Columbia, (for 1944), p. 84. Roark, 1945, U.S. Dept. Agric., Bur. Ent. Plant. Quar., **E-652**, (mimeographed), p. 27. Ballou, 1945, Cuaderno Verde No. **34**, Com. Organ. 3a Conf. Interamer. Agric., Caracas, pp. 76 and 125 (Venezuela; Mucurubá, State of Mérida). Herman, 1945, California Fish Game, **31**, pp. 17 and 20, fig. 9*D*. Dikmans, 1945, Amer. Jl. Vet. Res., **6**, p. 228. Cobbett and Smith, 1945, California Wool Grower, **21**, No. 39, p. 8; 1945, Jl. Amer. Vet. Med. Assoc., **107**, p. 147. Matthysse, 1945, Jl. Econ. Entom., **38**, p. 285. Freire, 1945, Bol. Dir. Prod. Animal, Sec. Agric. Ind. Com., Rio Grande do Sul, **1**, pt. 2, pp. 22, 27 [as *Mellophagus ovinus*], and 37 (Brazil: Rio Grande do Sul). Benbrook, 1945 List Parasites Domesticated Animals North America, 1st Ed., p. 35 (reprinted, 1946 and 1948). Schwardt and Matthysse, 1945, New York [Geneva] Farm Res., **11**, No. 2, pp. 11-12. Schwardt, 1945, *Op. cit.*, **11**, No. 4, pp. 4–5. Schwardt (*et al.*), 1945, **57th** Rept. New York Agric. Expt. Sta. Cornell, p. 124; 1946, *idem*, **58th** Rept., p. 119. Moreno, 1945, Almanaque Minist. Agric. Nac., Buenos Aires, **20**, p. 287; 1946, Campo y Suelo Argent., **30**, No. 351, p. 6. Gunn, 1946, 40th Ann. Rept. Dept. Agric. British Columbia, (for 1945), pp. V114–V115. Manson (*et al.*), 1946, Canadian Ins. Pest Rev., **24**, p. 103. Peters and Deyoe, 1946, Raising Livestock, pp. 289–290. Schwartz, 1946, Proc. **49th** Ann. Meet. U.S. Livestock San. Assoc., (1945), p. 75. Daggy (*et al*), 1946, Minnesota Agric. Expt. Sta., Ext. Bull. **252**, p. 9. Leary, Fischbein, and Salter, 1946, DDT and the Insect Problem, p. 91. Telford and Guthrie, 1946, Agric. Chem., **1**, No. 3, p. 30. Harney, 1946, National Wool Grower, **36**, No. 6, pp. 17–18. Manis, 1946, Idaho Coll. Agric., News Letter **31**, pt. 1, p. 3. Shull (*et al.*), 1946, Univ. Idaho, Ext. Bull. **268**, p. 38. Muma, 1946, Univ. Nebraska Coll. Agric., Extension Circ. **1539**, p. [2; unnumbered]. Rude and Parish, 1946, U.S. Dept. Agric., Bur. Ent. Plant Quar., **E-679**, (mimeographed), p. 1. Procter, 1946, Biol. Surv. Mt. Desert, **7**, Insect Fauna,

p. 437. Steinhaus, 1946, Insect Microbiology, pp. 54, 205, 244, 312, 313, and 480; figs. 115–117 and 202–203 (*Rickettsia melophagi; Trypanosoma melophagium*). Stuardo, 1946, Catálogo Dípteros Chile, p. 187. Kemper, Roberts, Smith, and Cobbett, 1947, Jl. Amer. Vet. Med. Assoc., **111**, p. 196. Schwartz (*et al.*), 1947, Proc. **50th** Ann. Meet. U.S. Livestock San. Assoc., (1946), p. 97. Roveda and Ringuelet 1947, Gaceta Veter., Buenos Aires, **9**, No. 46, p. 70. Anduze, Pifano, and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Twinn, 1947, Dept. Agric. Canada, Div. Entom., Processed Bull. **65**, pp. 8 and 10. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, pts. 3–4, (for 1944), p. 155 (St. Croix I.). Stuckey, 1947, **59th** Rept. Georgia Agri. Expt. Sta., p. 49. E.T. Baker, 1947, Management and Feeding of Sheep, pp. 217–223. Gardiner, 1947, Rept. Canadian Min. Agric., (for 1945–1946), p. 157. Price, 1947, Kentucky Agric. Expt. Sta., Ext. Circ. **438**, pp. 4–5. McDonald, 1947, North Dakota Agric. Expt. Sta., Ext. Circ. **190**, pp. 33–35, fig. Trullinger (*et al.*), 1947, U.S. Dept. Agric., O.E.S. Rept., (for 1945–1946), p. 112. Munro, 1947, Proc. Amer. Assoc. Econ. Entom., N. Centr. States Branch, **2**, p. 36. Gregson and Manson, 1947, Canad. Insect Pest Rev., **25**, p. 115. O'Connell, 1947, Wool Sack, **15**, No. 8, p. 2. Manis (*et al.*), 1947, Univ. Idaho, Ext. Bull. **269**, p. 30. Reyes, 1947, Rev. Grancolombiana Zoot. Hig. Med. Vet., Caracas, **1**, Nos. 10–12 p. 707 (Colombia); 1948, Rev. Med. Vet., Bogotá, **17**, No. 96, p. 71 (Colombia). Schwartz, 1948, U.S. Dept. Agric., Yearbook for 1943–1947, pp. 73–74. Telford, 1948, Jl. Econ. Entom., **40**, (for 1947), pt. 6, p. 921. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, p. 431, figs. 232 (distribution in Wisconsin) and 256 (Wisconsin: Madison, Dane Co.; Sun Prairie). Kemper, Cobbett, and Roberts, 1948, North Amer. Veter., **29**, pt. 7, pp. 422 and 424. H.H. Ross, 1948, Textbook of Entomology, p. 421, fig. 383. Ringuelet, 1948, Publ. Misc. Min. Agric. Argentina, No. **281**, pp. 41, 47, and 49 (Argentina: Abra Pampa, Jujuy, on goat; Carahuasi, Jujuy; Javimana, Molinos, Salta; Rosario de Lerma, Salta; zona cordillera, Salta; Concepción, Tucumán; Santa María, Catamarca; Chos Malal, Neuquen; Piedra Parada, Lanquineo, Chubut; Tehuelches, Chubut; Trelew, Chubut). Schwardt and Matthysse, 1948, Cornell Univ. Agric. Expt. Sta., Bull. **844**, pp. 1–33, fig. on cover (adult) and fig. 1 (p. 3: puparium). Swain, 1948, The Insect Guide, p. 214, fig. 174*a*. Goodman, 1948, San Luis Valley Farmer Stockman, **2**, No. 24, p. [10; unnumbered]. Watson, 1949, Jl. Amer. Vet. Med. Assoc., **115**, pp. 176 and 177 (Peru: in Andes between 10,000 and 15,000 ft.). Tibbetts and Sorenson, 1949, Farm Home Sci. [Utah State], **10**, pt. 1, p. 14. Steinhaus, 1949, Principles Insect Pathology, pp. 146, 155 and 156 (*Rickettsia melophagi*). Dicke, 1949, Proc. Amer. Assoc. Econ. Entom., N. Centr. States Branch, **4**, (mimeographed), p. 84. Florenzano, 1949, Redia, Florence, (2), **34**, p. 127 (*Bacillus anthracis*). Dicke, Pope, Bray, and Hanning, 1949, Jl. Agric. Res., **78**, p. 565. Pepper, Hitchcock, Hunt, and Schmiedeskamp, 1949, Montana Agric. Expt. Sta., **32nd** Rept. State Entom., Bull. **457**, p. 23. Denning, 1949, Jl. Econ. Entom., **42**, p. 852. Fairchild, Hoffman, Lindquist, and Mote, 1949, *Op. cit.*, **42**, p. 410. Gjullin, 1950, *Op. cit.*, **42**, (for 1949), pt. 6, p. 984. Hoffman, Roth, and Lindquist, 1950, *Op. cit.*, **42**, (for 1949), pt. 6, p. 893. Hoffman, 1950, *Op. cit.*, **42**, (for 1949), pt. 6, p. 984 (control of puparia). Ure (*et al.*), 1950, Rept. Alberta Dept. Agric. for 1949, p. 40. Seghetti and Firehammer, 1950, Jl. Amer. Vet. Med. Assoc., **117**, p. 447 (Montana). Schwardt, 1950, Agric. Chem., **5**, pt. 3, p. 88. Webber, 1950, in Craighead, Insect Enemies Eastern Forests, (U.S. Dept. Agric. Misc. Publ. No. **657**), (for 1949), p. 529. Herms, 1950, Medi-

cal Entomology, 4th Ed., p. 410, fig. 136. Denning and Pfadt, 1950, Wyoming Agric. Expt. Stat., Dept. Entom., (processed), p. 2. Manis and Portman, 1950, Idaho Agric. Expt. Sta., Bull. **279**, p. 66. de Buen, 1950, An. Inst. Biologia, México, **21**, pt. 2, p. 415 (Mexico: Chapingo, State Mexico, 2700 m., on sheep and goat; Temamatla, State of Mexico, 2200 m., on sheep). J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, (for 1950), p. 7. Crichton, 1951, Ent. Mo. Mag., **87**, p. 21 (main island of Tristan da Cunha). Craig and Faust, 1951, Clinical Parasitology, 5th Ed., p. 722. Simms, 1951, U.S. Dept. Agric., Bur. Anim. Ind., Rept. for 1949–1950, pp. 61–62. Hegner and Stiles, 1951, College Zoology, 6th Ed., p. 324, fig. 161*E*. Storer, 1951, General Zoology, 2nd Ed., p. 527, fig. 23 (29*F*). Wolcott, 1951, Jl. Agric. Univ. Puerto Rico, **32**, (for 1948), pt. 3, p. 530. Seghetti, 1951, Montana Wool Grower, **25**, No. 4, p. 9 (control). Belschner, 1951, Sheep Management Diseases, 2nd Ed., p. 608, fig. 309 (probably same in 1950 Ed.). Makino, 1951, Atlas Chrososome Numbers Animals, p. 212. Pepper, Corkins, Schmiedeskamp, Hunt, Anderson, and Wright, 1951, Montana Agric. Expt. Sta., **33rd** Rept. State Entom., Bull. **474**, p. 30. Knipling, 1951, U.S. Agric. Bur. Ent. Plant Quar., **E-762**, (2nd Revision), pp. 3, 7, 9, and 12–13. Schwartz (*el al.*), 1951, Proc. **54th** Ann. Meet. U.S. Livestock Sanit. Assoc., (1950), p. 258. Gardiner, 1951, Min. Agric. Canada, Rept. for 1950–1951, p. 13. Hagan, 1951, Embryology of the Viviparous Insects, pp. 161–203, figs. 35–49 (development). Metcalf and Flint, 1951, Destructive Useful Insects, 3rd Ed., p. 939, figs. 560–562. Hoffman and Lindquist, 1951, Jl. Econ. Entom., **44**, pt. 6, p. 928. Gallo and Vogelsang, 1951, Rev. Med. Veter. Paras., Caracas, **10**, Nos. 1–4, p. 35 (Venezuela). Robb, 1952, Rec. Stockman, Annual Ed., (for 1952), pp. 222 and 224. Muma, Hill, Hixson, and Harris, 1952, Jl. Econ. Entom., **45**, pt. 5, p. 833. Benbrook, 1952, List Parasites Domesticated Animals North America, 2nd Ed. (revised), p. 52. (Anonymous), 1952, Univ. Illinois, Agric. Expt. Sta., Circ. **698**, p. 123, fig. Corrêa, 1952, Bol. Dir. Prod. Anim., Rio Grande do Sul, **8**, No. 13, p. 4; Pl., fig. 2 (Brazil: Rio Grande do Sul). Chagnon, 1952, Contrib. Inst. Biol. Université Montréal, No. **32**, p. 34 (Quebec). Knipling and Bishopp, 1952, Trans. IXth Internat. Ent. Congr. Amsterdam, (1951), **1**, p. 933. Newsom, 1952, Sheep Diseases, p. 137, fig. 54. Riley and Wallace, 1952, Introduction Study Animal Parasites, 6th Ed., p. 77. Pfadt and DeFoliart, 1952, Wyoming Agric. Expt. Sta., Mimeogr. Circ. **23**, p. 1. Kemper, 1952, National Wool Grower, **42**, pt. 7, p. 21. Belding, 1952, Textbook Clinical Parasitology, 2nd Ed., p. 838. Hedeen, 1953, Texas Jl. Sci., **5**, pt. 1, p. 129 (Texas: Fort Hood). Pfadt, Paules, and DeFoliart, 1953, Jl. Econ. Entom., **46**, p. 95. Tagle, 1953, Agricultura Técnica, Santiago de Chile, **13**, Pt. 2, pp. 96 and 107. Strickland, 1953, Canadian Jl. Zool., **31**, No. 3, p. 290, fig. 50 (ptilinum). Kemper and Peterson, 1953, U.S. Dept. Agric., Farmers' Bull. **2057**, pp. 1–22, figs. 1*A*, 2*A–C*, 3*A–B*, 4, and 5. Snodgrass, 1953, Smithson. Misc. Coll., **122**, No. 3, pp. 13, and 18, fig. 4 (development of larval head). Longhurst and Douglas, 1953, Trans. **18th** North Amer. Wildlife Conf., pp. 177 and 183 (California: Hopland, Mendocino Co.). León and Castillo de León, 1953, Rev. Ecuatoriana Ent. Paras., **1**, No. 4, p. 55 (Ecuador: common in the Altiplano). Kemper, Cobbett, and Peterson, 1953, Vet. Medicine, **48**, p. 483. Nelson and Slen, 1953, Canadian Jl. Agric. Sci., **33**, p. 620 (Alberta: Lethbridge). Nelson, 1953, Proc. Canadian Soc. Anim. Prod., (mimeographed), p. [17]; 1953, Agric. Institute Rev., Ottawa, **8**, pt. 3, p. 34. Pfadt, DeFoliart, and Robb, 1953, Wyoming Agric. Expt. Sta., Bull. **327**, pp. 37 (fig.) and 55. Gregson,

1953, Proc. 7th Pacific Sci. Congr., (New Zealand, 1949), **4**, pp. 146 and 187 (British Columbia). Borror and DeLong, 1954, Introduction Study Insects, p. 643, fig. 27 (91). Whiting, Nelson, Slen and Bezeau, 1954, Canadian Jl. Agric. Sci., **34**, p. 70. Hill, Hixson, and Harris, 1954, Nebraska Agric. Expt. Sta. Q., **3**, Summer Issue, p. 8, fig. Jones, 1954, Veterinary Pharmacology Therapeutics, p. 586. White, 1954, Animal Cytology Evolution, 2nd Ed., p. 222. Hoffman, 1955, Jl. Econ. Entom., **48**, p. 629 (ecology). Pfadt and Ryff, 1955, *Op. cit.*, **48**, p. 195.

References using only a vernacular name (sheep-tick or ked): Perkins, 1880, **6th** Rept. Vermont Bd. Agric., p. 58, fig. 2 (uses "sheep-tick" [not *M. ovinus*, as listed in 1942*a*], p. 164). Gaiger, 1917, Jl. Comp. Path. Therap., **30**, p. 187 (Peru: in Andes above 10,000 ft).) Bell, 1922, Mo. Bull. Ohio Agric. Expt. Sta., **7**, Nos. 9–10, p. 152, figs. (adult, puparium). Cleveland, 1922, Purdue Univ. Dept. Agric., Ext. Bull. **105**, p. 4 (1940, 1945, revised by Davis). Hall, 1928, U.S. Dept. Agric., Misc. Publ. **25**, p. 8, fig. 13. Rawson, 1934, Scientific Mo., **39**, p. 504. Babcock, 1938, Ann. Rept. Texas Agric. Expt. Sta., **50**, (for 1937), p. 272. McDonald, 1940, Iowa Agric. Expt. Sta., Bull. **P-4**, p. 177. Stuckey, 1940, Ann. Rept. Georgia Expt. Sta., **52**, (for 1939–1940), p. 48; 1941, *Op. cit.*, **53**, (for 1940–1941), p. 78; 1942, *Op. cit.*, **54**, (for 1941–1942), p. 51; 1943, *Op. cit.*, **55**, (for 1942–1943), p. 29. Hagan, 1943, Infectious Diseases Domestic Animals, p. 392 (*Trypanosoma melophagium*). Smith and Kelly, 1943, Jl. Kansas Ent. Soc., **16**, p. 3; 1944, *Op. cit.*, **17**, p. 95. Kelly, 1944, Kansas Farmer, **81**, No. 8, p. 22. Stuckey, 1944, Ann. Rept. Georgia Expt. Sta., **56**, (for 1943–1944), p. 38; 1945, *Op. cit.*, **57**, (for 1944–1945), p. 36. Smith and Kelly, 1945, Jl. Kansas Ent. Soc., **18**, p. 93. Miller, 1945, U.S. Dept. Agric., Rept. Bur. Anim. Ind., (for 1944–1945), p. 34. Shull, Holm and Manis, 1945, Univ. Idaho, Ext. Circ. 88, p. 2 (revised: 1946, Circ. **92**, p. 2). Simms, 1946, U.S. Dept. Agric., Rept. Bur. Anim. Ind., (for 1945–1946), pp. 2 and 48. Smith, Dean, and Kelly, 1946, Jl. Kansas Ent. Soc., **19**, p. 50. Stuckey, 1946, Ann. Rept. Georgia Expt. Sta., **58**, (for 1945–1946), p. 48; 1947, *Op. cit.*, **59**, (for 1946–1947), p. 49. Bear, 1947, Ohio Farmer, **199**, No. 12, p. 13. Smith, Dean and Kelly, 1947, Jl. Kansas Ent. Soc., **20**, pp. 55 and 58. Kammlade, 1947, Sheep Science, p. 470. Dicke, Morgan and Pope, 1948, Ann. Rept. Univ. Wisconsin Expt. Sta., Bull. **474**, p. 15. Welch, 1949, Montana Wool Grower, **23**, No. 3, p. 6. Schwardt, 1950, Ann. Rept. Coll. Agric. Cornell Univ., **62**, (for 1949), p. 146. Rogoff, 1950, Rept. South Dakota Agric. Expt. Sta., **63**, p. 126. Hill, Hixson, and Muma, 1950, Ann. Rept. Nebraska Agric. Expt. Sta., **63**, p. 78. Cox, Bell, and Reed, 1951, Kansas Agric. Expt. Sta., Bull. **348**, p. 72. (Anonymous), 1951, Wisconsin Agric. Coll. Ext. Spec. Circ., pp. 1–4. (Anonymous), 1951, U.S. Dept. Agric., Agr. Res. Admin., Leafl. **308**, p. 3, fig. Knowlton, Keetch, and Binns, 1952, Utah State Agric. Coll., Ext. Circ. **156**, p. 1, fig. Knipling, 1952, U.S. Dept. Agric., Yearbook for 1952, "Insects," p. 665. MacNay, 1952, Ann. Rept. Ent. Soc. Ontario, **82**, (for 1951), p. 111 (British Columbia). Dunlap, 1953, Washington State Coll., Dept. Anim. Husb., Stockmen's Handb., p. 76. Price and Rodriguez, 1953, Kentucky Agric. Coll., Ext. Circ. **477**, p. 8. Brannon, 1954, Washington State Coll., Dept. Anim. Husb., Stockmen's Handb., p. 109. Nelson, 1955, Jl. of Parasitology, **41**, p. 635 (artificial feeding through animal membranes). Roselle, 1956, Univ. Nebraska Coll. Agric., Ext. Circ. **56**, p. 4.

Distribution and Additional Records (since 1942). ALASKA (recorded by Ferris and Cole, 1922, at the Yukon Boundary; J. Bequaert, 1942).

DOMINION OF CANADA. ALBERTA (recorded by Strickland, 1938; Gwatkin, Painter and Moynihan, 1942). — BRITISH COLUMBIA

(recorded by Spencer, 1938; J. Bequaert, 1942; MacNay, 1952; Gregson, 1953): Kamloops (G.B. Rich. — According to Mr. Rich, *in litt.*, 1952, throughout British Columbia wherever sheep are maintained, certainly as far north as Vavenby, about 51° 40′ N., 119° 45′ W.). — Ontario (recorded by J. Bequaert, 1942). — Quebec (recorded by Winn and Beaulieu, 1932; Whitehead, 1942; J. Bequaert, 1942; Chagnon, 1952).

United States. Arizona: Toreva, Navajo Co.; Fort Defiance, Apache Co. — Arkansas: Blytheville, Mississippi Co. — California (recorded by J. Bequaert, 1942): Lakeport, Lake Co. (L.C. Barnard); Topaz, Mono Co. (J.L. Webb); Taylorsville, Plumas Co. (C. Curtice); Kelseyville, Lake Co. (W.G. Upton); Palo Alto, Sa. Clara Co. (W.J. Jellison); Alkali Lake, Modoc Co. (F.C. Bishopp). — Colorado (recorded by Stiles, 1901; Hall, 1912; J. Bequaert, 1942): Colorado Springs (M.C. Hall); Amo, El Paso Co. (M.C. Hall); Resolis, Elbert Co. (M.C. Hall). — Connecticut (recorded by Johnson, 1925; J. Bequaert, 1942): Essex, Middlesex Co. (W.E. Britton). — Delaware: Nassau, Sussex Co. (D. MacCreary). — District of Columbia (recorded by J. Bequaert, 1942). — Idaho: Martin, Butte Co. (M.D. Martin); Clawson, Teton Co. (J. Heurle); Malad City, Oneida Co. (D.C. Ray); Sunnyside, Elmore Co. (E.N. Raymond); Camas, Jefferson Co. (A.H. Ulric); Bellevue, Blaine Co. (O.J. Allen). — Illinois (recorded by McCauley and Russell, 1940; J. Bequaert, 1942): Antioch, Lake Co.; Milford, Iriquois Co. (H. Duis); Decatur, Macon Co. (R.B. Peverly); Avon, Fulton Co. (W.F. Rapp). — Iowa (recorded by J. Bequaert, 1942). — Kansas (recorded by J. Bequaert, 1942). — Kentucky (recorded by J. Bequaert, 1942). — Louisiana: Washington Parish (E.S. Tucker). — Maine (recorded by Johnson, 1925; Procter, 1938; J. Bequaert, 1942): Bangor, Penobscot Co. (L.S. Lippincott); Lake Shore, Kennebec Co., on local sheep, 1946 (McTaggart). — Maryland (recorded by J. Bequaert, 1942): Hyattsville, Prince Georges Co. (R.T. Habermann); Beltsville, Prince Georges Co. (Underwood); Bethesda, Montgomery Co. (Foster); Norbeck (J.W. Davis). — Massachusetts (recorded by Johnson, 1925; J. Bequaert, 1942): Martha's Vineyard, on local sheep of two farms, November, 1941 (C.N. Smith and M.M. Cole); Rochester, Plymouth Co. (C. Mathews); Naushon I., Dukes Co. (F.C. Bishopp). — Michigan (recorded by J. Bequaert, 1942): Ann Arbor, Washtenaw Co. (R.M. Bailey). — Minnesota (recorded by Washburn, 1905; J. Bequaert, 1942). — Mississippi: Calyx, Noxubee Co. (C.S. Field);

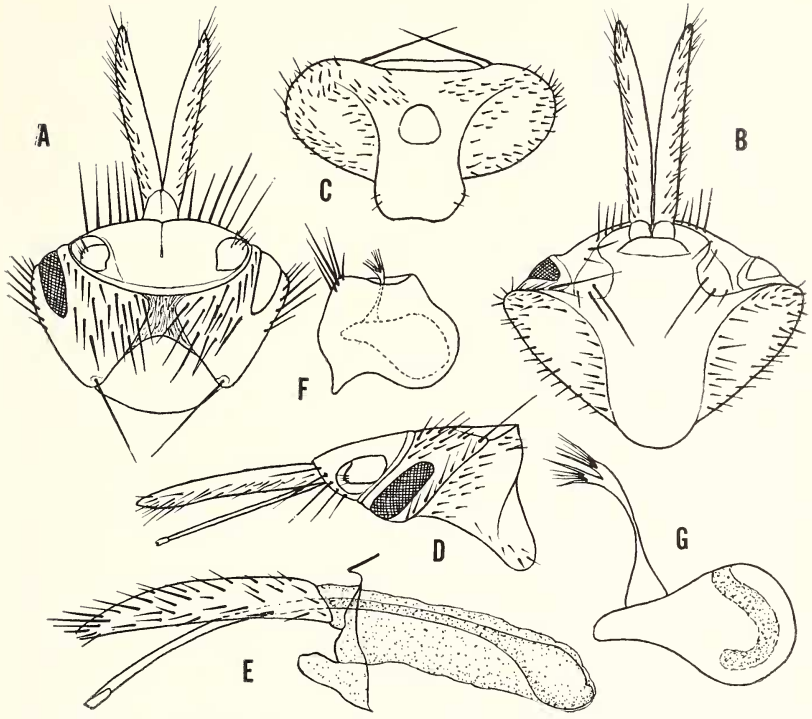

Fig. 104. *Melophagus ovinus* (Linnaeus). **A-D**, head, ♂, Bogotá, Colombia, from above (**A**), below (**B**), behind (**C**), and in side view (**D**); **E**, palpi and partly retracted mouth-parts, ♂, from the side; **F**, antenna removed from pit, ♂; **G**, 3rd antennal segment and arista, removed from 2nd segment, ♂.

Holly Springs, Marshall Co. (T.F. McGehee). — Montana (recorded by Seghetti and Firehammer, 1950; J. Bequaert, 1942): French Basin, Ravalli Co. (W.L. Jellison); Jeffers, Madison Co. (C. Carlson); Lolo, Missoula Co. (W.V. King); Silverton (L. Dern). — Nebraska (recorded by Swingle, 1909): North Platte, Lincoln Co. (Donna Peterson). — Nevada (recorded by J. Bequaert, 1942). — New Hampshire (recorded by Johnson, 1925; J. Bequaert, 1942): Sandwich, Carroll Co.; Lancaster, Coos Co.; Bedford, Manchester Co. (F.M. Crowell). — New Jersey (recorded by Johnson, 1900, 1910): Morristown, Morris Co. (A.F. Ohnsted). — New Mexico (recorded by Austen, 1906; J. Bequaert, 1942): Pecos, San Miguel Co. (T.D.A. Cockerell); Jicarilla Apache Reservation, Lincoln Co. (S.W. Wiest). — New York (recorded by Pratt, 1899; Felt, 1900; Leonard, 1928; J. Bequaert, 1942):

Montauk Point, Long Island; Hamilton Co. (J. Heller); Herkimer, Herkimer Co. (F.C. Bishopp); [Stony and Falleo Is., Lake Ontario, Jefferson Co.; Gorham, Ontario Co.; Logan, Monterey and Mecklenburg, Schuyler Co.; Belfast, Allegany Co.; North Collins, Erie Co.; vicinity of Ithaca, Tompkins Co.; all on local sheep; according to H.H. Schwardt, *in litt.*, 1941; specimens not seen]. — North Carolina (recorded by Brimley, 1938): Farmington, Davie Co. (C.S. Brimley). — Ohio (recorded by Mote, 1914, 1922; J. Bequaert, 1942): Duncan Falls, Muskingum Co. (P.R. Lowry). — Oklahoma (recorded by J. Bequaert, 1942). — Oregon (recorded by Cole and Lovett, 1921; J. Bequaert, 1942): Dayville, Grant Co., on *Odocoileus h. hemionus* (Stage-Hendricks; one specimen, at U.S.Nat.Mus.); Grass Valley, Sherman Co.; Independence, Polk Co. (R.H. Nelson); Adel, Lake Co. (F.C. Bishopp). — Pennsylvania (recorded by Pratt, 1899; Haimbach, 1907; J. Bequaert, 1942). — Rhode Island: Kingston, Washington Co. (received from H. Knutson). — South Dakota: Aberdeen, Brown Co., on a hog (W.E. Dove). — Texas (recorded by Babcock and Parish, 1936; J. Bequaert, 1942; Hedeen, 1953): Kerrville, Kerr Co. (J.D. Mitchell). — Utah (recorded by Knowlton, Harmston and Stains, 1939; J. Bequaert, 1942): Price, Carbon Co. (Stewart); Cove, Cache Co. (H.H. Allen); Falcon (H.E. Sweetman); Salina, Sevier Co. (M.A. Freece); Snowville, Box Elder Co. (J.J. Larkin); Promontory, Box Elder Co. (F.C. Bishopp); Mendon, Cache Co. (J. Baker). — Vermont: Brattleboro, Windham Co. — Virginia (recorded by J. Bequaert, 1942): Vienna, Fairfax Co. (E.A. Chapin). — Washington (State) (recorded by Hatch, 1938; J. Bequaert, 1942): Fruitland, Stevens Co. (J.S. McLean); Clallam Co. (G. Docker); Winona, Whitman Co. (A. Aanestad; J. Lamb). — West Virginia (recorded by Hopkins, 1891). — Wisconsin (recorded by MacArthur, 1948): Sun Prairie, Dane Co. (Helen S. Renk); Madison (W.C. Campbell); Waukesha Co. — Wyoming (recorded by Swingle, 1913): Hudson, Fremont Co. (J.N. Davis); Waltman, Natrona Co. (F.C. Bishopp); Oil City (R. Grieve).

Mexico (recorded by Rondani, 1879; de Buen, 1950): Mexico City, D.F. (S.J. Bonansea); Jalapa, State Vera Cruz, 1922; Chapingo, State Mexico, on sheep and goat (Mrs. Ana María de Buen de Biagi, F. Biagi, E. Freyermuth, and P. Rojas).

Panama (recorded by J. Bequaert, 1942).

Colombia (recorded by Dunn, 1929; Reyes, 1938, 1947, 1948; Patiño-Camargo, 1940; J. Bequaert, 1942).

Venezuela (recorded by Vogelsang, 1939; Ballou, 1945; Gallo and Vogelsang, 1951).

Ecuador (recorded by Becker, 1919; J. Bequaert, 1942; León and Castillo de León, 1953).

Peru (recorded by Brues, 1915; Gaiger, 1917; Willie, Ocampo, Wederbauer, and Schofield, 1937, 1939; Watson, 1949).

Bolivia (recorded by Torregiani, 1949, 1919; Bau, 1930; J. Bequaert, 1942).

Brazil (recorded by Pinto, 1933; Corrêa, 1952): Belem, Pará, Jan. 22, 1952 (J.A. Munro) [presumably on freshly imported sheep].

Uruguay (recorded by Rubino and Calzada, 1940).

Argentina (recorded by Wolffhügel, 1911, 1912; Werneck, 1935; Girotto, 1940; Roveda and Ringuelet, 1947; Ringuelet, 1948): Gonzalo, Dept. Trancas, Prov. Tucumán, 1300 m. (J.P. Bellomo); Hualfín, Prov. Catamarca (S. Pierotti).

Chile (recorded by Philippi, 1886; Reed, 1904; Edwards and Shannon, 1927; J. Bequaert, 1942, 1951; Stuardo, 1946; Tagle, 1953): Castro, Chiloë I. (F. and M. Edwards and R.E. Shannon); Mocha I. (D.S. Bullock); the locality "Puren," given in 1942, should be "Puven."

Tristan da Cunha (recorded by Crichton, 1951).

Falkland Islands: Douglas Station, on sheep (W.P. Schmit).

Although there are as yet no definite records, *M. ovinus* probably occurs on sheep kept locally in Yukon Territory, Saskatchewan, Manitoba, New Brunswick, Nova Scotia, North Dakota, Indiana, and Tennessee; possibly also in Greenland. In South Carolina, Georgia, Florida, and Alabama its occurrence is more doubtful. Farther south it may be expected in the highlands of Guatemala and Costa Rica, from where there are no precise records thus far.

On the American continent, the sheep-ked breeds at present on locally raised sheep from about 64° N., in Alaska, to about 45° S., in Patagonia and Chile; but it is found farther south in the Falkland Islands (close to 52° S.). In the Andes it ascends to 11,000 ft. It is generally absent from the tropical lowlands, even when sheep are kept there. Although it may be observed there temporarily on sheep newly imported from infested areas, it does not become established.

There is no conclusive proof that *M. ovinus* is established permanently in the Antilles. A specimen at the U.S. National Museum is labelled Mayagüez, Puerto Rico (W.V. Tower), and Beatty (1947) cites the sheep-ked from the island of St. Croix.

Both records were almost certainly temporary introductions, based on specimens taken from sheep newly imported from outside the Antilles. Van Volkenberg (1939) definitely states that he failed to find it in Puerto Rico.

Bionomics. These are discussed in my Monograph (1942*a*, pp. 186–189) and in various sections of Part I of the present work. The only known normal breeding hosts of *M. ovinus* are domestic sheep and perhaps domestic goats. The true original wild host is actually unknown (Pt. I, pp. 310–312). In North America, as elsewhere, it occurs sometimes on domestic sheep gone feral and may pass from these temporarily to other hosts, such as possibly native wild sheep, mule deer, Alaskan wolf, and coyote. Occasionally it is found also on cattle, horse and even Man, all of which are abnormal hosts. Wolffhügel (1912, p. 462) reported an additional case of attack on Man in Argentina, not mentioned in Pt. I (p. 338).

The original descriptions of *Hippobosca ovina* Linnaeus and of its synonyms are copied in my Monograph (1942*a*). Linnaeus actually saw specimens of the sheep-ked, which he described or mentioned from Sweden in his earlier works (1747, 1748, 1754; cited in my 1942 Monograph). He also included it in the 2nd Edition of the Fauna Suecica (1761, p. 472), where he stated that it was more fully described in his "It. W: gothico" [1747, *Wästgöta Resa Foerrattad* 1746, p. 59]. Dr. F. Bryk wrote me (June, 1950) that there are now no Linnaean specimens of *M. ovinus* in any Swedish collection.

Some years ago I mentioned the use of the dog-fly, *Hippobosca longipennis*, in early Chinese medicine (J. Bequaert, 1939*b*, p. 81). Strange popular remedies are, however, by no means the monopoly of the Far East. Quecke (1951) has written an entertaining account of the former and present use of sheep-keds and lice as popular remedies. In certain rural districts of Germany, keds are to this day sometimes given by mouth to cure infectious jaundice (icterus or Weil's disease). As an amusing sidelight on the prevailing entomophobia, the "ked cure" is so loathsome to the patient that it is usually administered without his knowledge. At least one German physician (Rausch, 1948) went to the trouble of testing the possible therapeutic effects by treating 5 cases of jaundice with alcoholic extract of crushed keds. He even reported that the treatment seemed to improve some of the cases. His German colleagues were, however, more sceptical, as appears from an interesting controversy in the German medical literature (Bogendörfer, 1949, 1950; Hausmann, 1950; Münch, 1950; Rausch, 1949; Wigand and Hente, 1950; Wilms, 1950).

REGIONAL DISTRIBUTION IN AMERICA

The main features of the world distribution of the Hippoboscidae were discussed at some length in an earlier section of Part II (pp. 24–38). It may nevertheless be useful to review them in so far as they concern more particularly the New World.

A total of 47 species, belonging to 13 genera of the 3 subfamilies Ornithoicinae, Ornithomyiinae and Melophaginae, are now definitely recognized in the Americas. This compares with a total for the World of approximately 130 species, described and accepted as distinct to date, placed in 20 genera and 6 subfamilies.

Of the 47 American species, 41 are bird-flies and 6 mammal-flies. Three species, *Pseudolynchia canariensis, Lipoptena cervi* and *Melophagus ovinus,* should be omitted from further discussion, as they were introduced by Man within the past 2 or 3 centuries. This leaves 44 autochthonous (or native) hippoboscids, 40 of which occur on birds and 4 on mammals. As the global total of 130 species comprises 95 bird-flies and 35 mammal-flies, the percentage of mammal-flies in America (8 per cent) is far below that for the World as a whole (26 per cent).

Eight of the 44 autochthonous American flies occur under natural conditions in the Eastern Hemisphere also, all of these being bird-flies. One of them, *Ornithomyia fringillina,* is Holarctic. The remainder are more cosmopolitan, either occurring primarily on land birds (*Ornithoica confluenta, Lynchia nigra, L. albipennis,* and *Olfersia fumipennis*) or being restricted more to oceanic birds, mainly within the Tropics (*Olfersia spinifera, O. aenescens,* and *O. fossulata*).[66]

The number of American hippoboscids thus dwindles to 36 strictly precinctive species, of which 32 live on birds and 4 on mammals. On the other hand, 86 native precinctive flies are now recognized in the Old World, 55 on birds and 31 on mammals. The relative poverty of the New World hippoboscid fauna is shown also by the few genera peculiar to that area (3 in all: *Stilbometopa, Microlynchia* and *Neolipoptena*). In sharp contrast, in the Old World 8 of 17 genera (*Ornitheza, Stenepteryx, Hippobosca,*

[66] *Lynchia nigra* is here retained provisionally among the cosmopolitan species because of the reported two occurrences in Hawaii and Queensland; but both these records should be confirmed. Contrary to my earlier conclusion (Part II, pp. 316, 322, 323 and 329), the African *Lynchia dukei* Austen is specifically distinct from *L. nigra,* and there is at present no reliable evidence that the latter occurs in Africa.

Allobosca, Ortholfersia, Austrolfersia, Echestypus and *Melophagus*) and 3 of the 6 subfamilies (Hippoboscinae, Alloboscinae and Ortholfersiinae) are precinctive.

The superiority of the Old World in the Recent hippoboscid fauna, clearly shown by the foregoing figures, is in my opinion an actual fact. It does not merely reflect incomplete knowledge, but will only be enhanced by future investigations, as the louse-flies of the New World are at present much better known than those of the Old. It may be explained to a large extent by the preponderance of the mammal-flies, itself correlated with the rich Recent mammalian fauna of the Old World. As pointed out in Part I (p. 286), the order Artiodactyla, nowadays more abundant in Africa than elsewhere, contains more breeding hosts of Hippoboscidae and harbors more species of such flies than all other mammals combined. This order is poorly represented in the Recent American fauna. There is, however, no such ready explanation for the evident, albeit lesser, numerical superiority of the Old World bird-flies over those of the New, especially since the Neotropical bird fauna is richer and more varied than that of the Paleotropics. It may be due in part to the fact that certain orders or families of birds, with many genera and species in the American Tropics, contain no, or few, true breeding hosts of hippoboscids. Many or most Psittaciformes, Trogoniformes, Piciformes, Trochilidae, Formicariidae, Furnariidae, Cotingidae, and Thraupidae are seemingly avoided by these flies. Nevertheless I suspect that the difference may have a deeper, perhaps historical cause; but I know of no factual evidence that could be brought to bear on the problem.

The subjoined regional lists of the flies known at present from each of the major political entities of the New World (and from the provinces and states of Canada and the United States), were compiled for the convenience of local entomologists. They are of little general interest, except that they bring out the many gaps in our present knowledge of the geographical distribution and should warn us not to attempt a too detailed analysis of the available data. In North America, where the Hippoboscidae have been most thoroughly investigated, presumably few species will be added to those listed from Alaska, the Dominion of Canada, the United States, or even Mexico. Within the United States, however, few if any of the states could claim to be completely known. Texas now leads the list with 14 species, followed by Massachusetts (13), New York (12), Pennsylvania (12), Wisconsin (12), Kansas (11),

Florida (11), and California (11); but additional species will no doubt be discovered in the future in nearly every one of these states. For most of the other states the lists are a mere beginning. The situation is far less satisfactory for the remainder of Central America, the Antilles and South America. Brazil leads here with 30 species (more than the total known from the United States, a much better collected area), followed by Venezuela (22), Panama (21), Colombia (19) and Argentina (14); but, again, additions will certainly be made in every case.

In spite of such obvious deficiencies, the major features of the American hippoboscid fauna are now sufficiently known to attempt an analysis along the broad lines of the classical zoogeographical divisions. Those adopted here are: (1) the Nearctic Region, north of the Tropic of Cancer (23° 27′ N.); (2) the Neotropical Region, between the Tropics, including the Antilles; and (3) what will be called here the Neantarctic Region, south of the Tropic of Capricorn (23° 27′ S.).[67]

1. **Nearctic Region.** Although the Nearctic biota has, as a whole, much in common, factually as well as historically, with that of the Palearctic Region, there is little evidence of this among the Hippoboscidae. The 25 autochthonous Nearctic louse-flies comprise four geographical elements: (*a*) one Holarctic species, *Ornithomyia fringillina;* (*b*) 5 species likewise of the Old World, but more widespread there and at home in tropical rather than in temperate areas; (*c*) 14 essentially Neotropical species, which extend their range, either normally or accidentally, north of the Tropic of Cancer; and (*d*) 5 strictly Nearctic, precinctive species, *Myiophthiria fimbriata, Stilbometopa impressa, Lynchia hirsuta, Neolipoptena ferrisi,* and *Lipoptena depressa.* Thus the Nearctic

[67] The relatively small area of temperate South America, south of the Tropic of Capricorn, is customarily treated as a subdivision of the Neotropical Region, the so-called Chilian Subregion; and the corresponding extratropical parts of South Africa (South African Subregion) and of Australia (Australian Subregion) are similarly subordinated to the Ethiopian and Australian Regions. It would seem more in accordance with the facts, as well as more convenient in discussion, to group all temperate areas south of the Tropic of Capricorn in one Holantarctic Realm, the counterpart of the Holartic Realm of the Northern Hemisphere. This could then be divided into a Neantarctic, an Afroantarctic and an Austroantarctic Region.

hippoboscid fauna shows few affinities with that of the Palearctic Region. It also has little individuality. More than half of the species appear to be relatively recent invaders, which probably entered the Region mainly from the American Tropics, after the last Ice Age.

The foregoing analysis brings out once more that the Hippoboscidae are essentially tropical and subtropical insects, as I stressed before (Part I, p. 121; Part II, p. 36). If the records of the Nearctic louse-flies are arranged in zones according to latitude, it is found that the number of species decreases steadily from south to north. The southmost zone, between the Tropic of Cancer and 40° N., comprising the southern half of the United States and a small adjoining area of northern Mexico, harbors 24 of the 25 known Nearctic species. In the zone between 40° N. and 50° N., including approximately the northern half of the United States, a narrow southern strip of Canada, as well as the Maritime Provinces, the number decreases to 21, including 3 species found only west of the 100th Meridian. Moreover, there is a further decrease in the northmost section of this zone, as only 12 autochthonous species are known from the whole of the Dominion of Canada. In the vast continental area north of 50° N., most of the very few reported hippoboscids are accidental captures; there is probably only one truly native species, the widespread, but strictly Holarctic *Ornithomyia fringillina*. This has been taken as far north as 68° N., slightly beyond the Arctic Circle, and is the only native louse-fly reported from Alaska. As this fly occurs nowhere within the Tropics, it appears to have reached the New World by natural means by a northern route, presumably from northern Asia across Bering Strait, after the final retreat of the Ice.

In connection with the historical development of the fauna, it may be of some interest that the Nearctic hippoboscids are not all uniformly distributed from east to west across the continent. The 5 precinctive Nearctic species listed above are all restricted to the western half of the United States. On the other hand, 8 of the species known from the eastern United States have never been taken in the western half of the continent; these are all widespread Neotropical flies, which presumably extended their range northward through the humid southeastern states, but were unable to do so in the arid or semi-arid southwestern sections.

It should also be noted that, of the 5 cosmopolitan and of the 14 Neotropical flies recorded from the Nearctic Region, some scarcely qualify as true permanent members of the local fauna.

Ornithoica confluenta (1 Florida record), *Stilbometopa fulvifrons* (1 New Jersey record), *Olfersia spinifera* (2 Florida and Louisiana records) and *O. bisulcata* (3 Texas records) are so rarely recorded that they are not much more than accidental visitors. Even some of the more frequently captured flies, such as *Ornithoctona fusciventris*, *Stilbometopa podopostyla*, *Lynchia angustifrons*, *L. albipennis* and *L. holoptera*, are perhaps only summer residents, being unable to survive the winter, either as adults or as puparia, at least in the more northern sections of the United States and in Canada.

2. **Neotropical Region.** The 37 recognized, autochthonous Neotropical hippoboscids (35 bird-flies and 2 mammal-flies) are a more homogeneous lot than that of the Nearctic Region. Only the 7 cosmopolitan species listed above are an extraneous element. Three of the 7 may, moreover, be disregarded, as they are restricted to oceanic birds. Two others are world-wide parasites of waders (Ciconiiformes) and one is the specific parasite of the cosmopolitan osprey. This leaves *Lynchia nigra*, clearly a fly of Neotropical origin, but which is perhaps now extending its range by natural means to parts of the Old World.

Of the remaining 30 Neotropical flies, only 15 are strictly precinctive in the American Tropics; 14 extend, either normally or casually, to the Nearctic Region, while 10 have been reported from the Neantarctic Region. As a result, the following 11 species, or 25 per cent of all native American hippoboscids, are known to occur on the Continent from the United States or from southern Canada to Argentina. Except for *Lipoptena mazamae*, they are bird-flies.

Ornithoica vicina, from 50° N. to 41° 30′ S.
Ornithoctona erythrocephala, from 56° N. to 33° S.
" *fusciventris*, from 45° 30′ N. to 27° or 28° S.
Lynchia americana, from 49° N. to 30° S.
" *angustifrons*, from 46° N. to 27° S.
" *wolcotti*, from 46° 20′ N. to 27° 11′ S.
" *nigra*, from 56° 40′ N. to 28° S.
Microlynchia pusilla, from 46° 50′ N. to 25° 30′ S.
Pseudolynchia brunnea, from 48° 35′ N. to 41° S.
Olfersia bisulcata, from 29° 15′ N. to 23° 10′ S.
Lipoptena mazamae, from 33° 30′ N. to 27° 30′ S.

Very few other families of insects have as high a percentage of species with a comparable wide latitudinal range. The explanation for the unusual wide distribution of many hippoboscids is,

however, not far to seek. Each of the species listed above is either a pleioxenous or a polyxenous parasite (Part I, pp. 320 and 322), with a variety of suitable breeding hosts available over most of the American continent.

The extension of these flies to extratropical areas does not actually detract from the individuality of the Neotropical hippoboscid fauna. The important fact remains that the Neotropics have nowadays very few louse-flies in common with the Paleotropics, which are likewise the headquarters of these parasites in the Old World. The main reason for this is no doubt that a similar condition prevails for the birds, the leading hosts of the flies, particularly in the New World. The American bird fauna is characterized by several numerically important precinctive families, such as the Tinamidae, Cathartidae, Cracidae, Meleagridae, Trochilidae, Ramphastidae, Formicariidae, Furnariidae, Cotingidae, Tyrannidae, Vireonidae, Thraupidae, and Icteridae. Birds of these families are not only frequently infested with flies, but some of them are the only true breeding hosts of certain species. The Old World fauna in turn has a number of peculiar families of birds, which commonly serve as hosts for flies, such as the Struthionidae, Otitidae, Pteroclidae, Musophagidae, Coraciidae, Meropidae, Bucerotidae, Pittidae, Alaudidae, Pycnonotidae, Campephagidae, Meliphagidae, Ploceidae, Sturnidae, Oriolidae, and Dicruridae. In view of the small number of American mammal-flies, the fundamental differences between the Old World and the New World birds account sufficiently for their distinctive hippoboscid faunae. In each of these areas the evolution of the bird-flies obviously followed that of the birds. It might therefore be interesting to determine at approximately what time in geological history the two bird faunae started to diverge. Unfortunately there seems to be at present little factual evidence bearing on the matter, so that further speculation would be most hazardous.

The majority of the 30 autochthonous Neotropical flies are fairly uniformly distributed and the gaps in their ranges are mostly due to fragmentary knowledge. Three species are known thus far only from west of the Isthmus of Panama (*Ornithomyia hoffmannae*, *Ornithoctona orizabae* and *Microlynchia furtiva*) and 6 only from east of the Isthmus (*Ornithomyia ambigua*, *Crataerina seguyi*, *Myiophthiria neotropica*, *Ornithoctona oxycera*, *Microlynchia galapagoensis* and *Lipoptena guimaraesi*). It would be premature, however, to use these more localized flies as a valid argument for marking the Isthmus of Panama as a special zoogeo-

graphical boundary. They are bird-flies, with one exception, and mostly known at present from one or a few records, so that future collecting may extend their ranges greatly. The one mammal-fly, *L. guimaraesi*, is presumably a specific parasite of pampas deer (*Ozotoceros bezoarticus*), so that it will be restricted to the limited range of its host, from Bolivia and southern Brazil to northern Patagonia.

The far-flung archipelago of the Antilles harbors only a depauperate and commonplace Neotropical hippoboscid fauna. There are no native mammal-flies, owing to the lack of suitable wild hosts, particularly Artiodactyla. All of the 15 recorded bird-flies are known also from the American continent. With one possible exception, they are widespread elsewhere: 3 are oceanic throughout the Tropics (*Olfersia spinifera*, *O. aenescens* and *O. fossulata*); 4 are cosmopolitan on land (*Ornithoica confluenta*, *Lynchia albipennis*, *L. nigra* and *Olfersia fumipennis*); and 7 occur in the Neotropical and usually also in the Nearctic Regions (*Ornithoica vicina*, *Ornithoctona erythrocephala*, *O. fusciventris*, *Stilbometopa ramphastonis*, the oceanic *Olfersia sordida*, *Microlynchia pusilla* and *Pseudolynchia brunnea*). Possibly *Stilbometopa fulvifrons* may be a truly precinctive Antillean fly, as there are only 2 records thus far from the continent, and both appear to be based on accidental strays. Unfortunately the taxonomic status of this species is as yet uncertain, and it may eventually prove to be cospecific with *S. podopostyla*, a fly widely distributed on the continent. The 4 flies of oceanic birds are spread over most of the archipelago; the remaining 11 flies have all been taken in the Greater Antilles (Cuba, Jamaica, Hispaniola and Puerto Rico), but only 2 of them (*Ornithoctona erythrocephala* and *Microlynchia pusilla*) are known thus far from the Lesser Antilles. This is easily explained by the more varied bird fauna of the larger islands, as well as by their being used more extensively and more regularly as a bridge during the seasonal migrations and as winter quarters by many Nearctic birds.

3. **Neantarctic Region.** As compared with the foregoing two areas, the territory south of the Tropic of Capricorn (23° 27′ S.), here included in the Neantarctic Region, is very small. Its bird fauna is, moreover, relatively poor and shows few of the differences from the Neotropics which are such a striking feature of the Nearctic Region. Its Hippoboscidae have also been little investigated thus far, so that substantial additions to the list of the recorded species may be predicted. Omitting the unrecognized

Lynchia penelopes, 18 native louse-flies (17 bird-flies and 1 mammal-fly) are known from the area. It should be stressed that most of these are confined to the northern, warm temperate or subtropical section. Only 5 of the species (*Ornithoica vicina, Ornithomyia parva, Crataerina seguyi, Ornithoctona erythrocephala* and *Pseudolynchia brunnea*) have been taken south of 30° S. Of the 18 species, 17 occur in the Neotropics and 12 of these enter also the Nearctic Region. The hippoboscid fauna has therefore very little individuality. The one precinctive Neantarctic fly, *Ornithomyia parva,* is found on the continent between 26° S. and 39° S., as well as on the islands of Tristan da Cunha and Gough, in the southern Atlantic. This interesting insect is the Antarctic representative of the Holarctic *Ornithomyia fringillina.* The two species are so closely related that they appear to have been derived from a common, presumably extinct and more widespread ancestor. Both have a variety of suitable breeding hosts, but show a predilection for Passeriformes. Is it too far-fetched to assume that their putative common ancestor was likewise a polyxenous parasite?

In some other groups of animals and particularly of insects, the Neantarctic Region, or Chilian Subregion, has produced a wealth of peculiar genera and species, sometimes with overtones of circumpolar, Antarctic affinities. In contrast with these, the Hippoboscidae of temperate South America are a commonplace lot. They offer no tangible evidence in support of any of the current theories on the origin and further evolution of the South American fauna as a whole.

In summary, the main peculiarities of the hippoboscid fauna of the Americas are: (*a*) a relative poverty in species and supraspecific entities, as compared with the Old World; (*b*) a strong predominance of the bird-flies; (*c*) a marked individuality, little influenced by advecticious immigrants from the Old World; and (*d*) its essentially Neotropical character.

In the following list asterisks mark species introduced by Man from the Old World.

Alaska (2): *Ornithomyia fringillina; *Melophagus ovinus.*

Dominion of Canada (13). Alberta (5): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia nigra; L. albipennis; *Melophagus ovinus.* — British Columbia (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia nigra; L. albipennis; Olfersia fumipennis; Neolipoptena ferrisi; Lipop-*

*tena depressa; *Melophagus ovinus.* — LABRADOR (1): *Ornithomyia fringillina.* — MANITOBA (2): *Ornithoctona erythrocephala; Lynchia albipennis.* — NEWFOUNDLAND (1): *Ornithomyia fringillina.* — NOVA SCOTIA (3): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana.* — ONTARIO (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; Pseudolynchia brunnea; *Melophagus ovinus.* — QUEBEC (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. nigra; L. albipennis; Olfersia fumipennis; *Melophagus ovinus.* — SASKATCHEWAN (1): *Ornithomyia fringillina.*

UNITED STATES (27). ALABAMA (3): *Lynchia americana; L. albipennis; *Pseudolynchia canariensis.* — ARIZONA (10): *Ornithoica vicina; Ornithomyia fringillina; Myiophthiria fimbriata; Stilbometopa impressa; S. podopostyla; Lynchia americana; L. nigra; Microlynchia pusilla; *Melophagus ovinus.* — ARKANSAS (3): **Pseudolynchia canariensis; P. brunnea; *Melophagus ovinus.* — CALIFORNIA (11): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona fusciventris; Stilbometopa impressa; Lynchia americana; L. hirsuta; Microlynchia pusilla; *Pseudolynchia canariensis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.* — COLORADO (7): *Ornithoica vicina; Ornithomyia fringillina; Myiophthiria fimbriata; Lynchia americana; L. nigra; *Pseudolynchia canariensis; *Melophagus ovinus.* — CONNECTICUT (7): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; *Pseudolynchia canariensis; *Melophagus ovinus.* — DELAWARE (3): *Lynchia americana; *Pseudolynchia canariensis; *Melophagus ovinus.* — DISTRICT OF COLUMBIA (7): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona fusciventris; Lynchia americana;* (*Microlynchia pusilla*, on imported host); **Pseudolynchia canariensis; *Melophagus ovinus.* — FLORIDA (11): *Ornithoica confluenta; Ornithoctona erythrocephala; Lynchia americana; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. fumipennis; O. sordida; Lipoptena mazamae.* — GEORGIA (7): *Ornithoctona*

*erythrocephala; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Lipoptena mazamae.* — IDAHO (5): *Lynchia nigra; L. hirsuta; Microlynchia pusilla; Lipoptena depressa; *Melophagus ovinus.* — ILLINOIS (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; *Pseudolynchia canariensis; *Melophagus ovinus.* — INDIANA (2): *Lynchia americana; L. albipennis.* — IOWA (8): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; *Melophagus ovinus.* — KANSAS (11): *Ornithoica vicina; Ornithoctona erythrocephala; Stilbometopa podopostyla; Lynchia americana; L. nigra; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; *Melophagus ovinus.* — KENTUCKY (3): *Ornithoctona fusciventris; Lynchia americana; *Melophagus ovinus.* — LOUISIANA (10): *Ornithoica vicina; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; Olfersia spinifera; O. fumipennis; O. bisulcata; O. sordida; Lipoptena mazamae; *Melophagus ovinus.* — MAINE (5): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; *Melophagus ovinus.* — MARYLAND (10): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; *Pseudolynchia canariensis; P. brunnea.* — MASSACHUSETTS (13): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; L. holoptera; *Pseudolynchia canariensis; P. brunnea; *Lipoptena cervi; *Melophagus ovinus.* — MICHIGAN (10): *Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. wolcotti; L. angustifrons; L. albipennis; Pseudolynchia brunnea; Olfersia fumipennis; *Melophagus ovinus.* — MINNESOTA (10): *Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. nigra; L. albipennis; Pseudolynchia brunnea; Olfersia fumipennis; *Melophagus ovinus.* — MISSISSIPPI (5): *Ornithoctona erythrocephala; Lynchia americana;*

*L. albipennis; *Pseudolynchia canariensis; *Melophagus ovinus.* — Missouri (5): *Ornithoica vicina; Ornithoctona erythrocephala; Lynchia americana; L. angustifrons; L. albipennis.* — Montana (7): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia nigra; L. albipennis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.* — Nebraska (9): *Myiophthiria fimbriata; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; Lynchia americana; L. wolcotti; L. albipennis; Microlynchia pusilla; *Melophagus ovinus.* — Nevada (5): *Stilbometopa impressa; Lynchia americana; L. hirsuta; *Pseudolynchia canariensis; *Melophagus ovinus.* — New Hampshire (10): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; L. wolcotti; L. angustifrons; L. albipennis; Olfersia fumipennis; *Lipoptena cervi; *Melophagus ovinus.* — New Jersey (10): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa fulvifrons; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; Olfersia fumipennis; *Melophagus ovinus.* — New Mexico (8): *Ornithoica vicina; Ornithomyia fringillina; Myiophthiria fimbriata; Stilbometopa impressa; Lynchia nigra; Microlynchia pusilla; Pseudolynchia brunnea; *Melophagus ovinus.* — New York (12): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. nigra; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; *Lipoptena cervi; *Melophagus ovinus.* — North Carolina (8): *Ornithoica vicina; Ornithoctona erythrocephala; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; *Melophagus ovinus.* — North Dakota (4): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; Microlynchia pusilla.* — Ohio (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; L. holoptera; Pseudolynchia brunnea; Olfersia fumipennis; *Melophagus ovinus.* — Oklahoma (3): *Stilbometopa podopostyla; Lynchia albipennis; *Melophagus ovinus.* — Oregon (8): *Ornithoica vicina; Ornithomyia fringillina; Lynchia americana; Olfersia fumipennis; O. sordida; Neolipoptena ferrisi;*

*Lipoptena depressa; *Melophagus ovinus.* —Pennsylvania (12): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; L. holoptera; *Pseudolynchia canariensis; Olfersia fumipennis; *Lipoptena cervi; *Melophagus ovinus.* — Rhode Island (2): *Lynchia americana; *Melophagus ovinus.* — South Carolina (7): *Ornithoica vicina; Lynchia americana; L. albipennis; L. holoptera; *Pseudolynchia canariensis; P. brunnea; Lipoptena mazamae.* — South Dakota (5): *Ornithomyia fringillina; Lynchia albipennis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.* — Tennessee (7): *Ornithoica vicina; Ornithomyia fringillina; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis.* — Texas (14): *Ornithomyia fringillina; Stilbometopa podopostyla; Lynchia americana; L. angustifrons; L. nigra; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; O. bisulcata; O. sordida; Lipoptena mazamae; *Melophagus ovinus.* — Utah (7): *Ornithoica vicina; Ornithomyia fringillina; Myiophthiria fimbriata; Lynchia nigra; L. hirsuta; Olfersia sordida; *Melophagus ovinus.* — Vermont (6): *Ornithoica vicina; Ornithomyia fringillina; Lynchia americana; Olfersia fumipennis; O. bisulcata; *Melophagus ovinus.* — Virginia (9): *Ornithoica vicina; Ornithoctona fusciventris; Lynchia americana; L. angustifrons; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; *Melophagus ovinus.* — Washington (State) (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona fusciventris; Lynchia americana; L. nigra; L. albipennis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.* — West Virginia (5): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; *Melophagus ovinus.* — Wisconsin (12): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. nigra; L. albipennis; L. holoptera; *Pseudolynchia canariensis; Olfersia fumipennis; *Melophagus ovinus.* — Wyoming (7): *Ornithomyia fringillina; Myiophthiria fimbriata; Lynchia*

*nigra; L. albipennis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.*

Mexico (28): *Ornithoica vicina; Ornithomyia fringillina; O. hoffmannae; Ornithoctona erythrocephala; O. orizabae; O. fusciventris; O. nitens; Stilbometopa impressa; S. podopostyla; S. legtersi; Lynchia americana; L. angustifrons; L. wolcotti; L. nigra; L. albipennis; L. plaumanni; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. aenescens; O. fumipennis; O. bisulcata; O. sordida; O. coriacea; Neolipoptena ferrisi; Lipoptena mazamae; *Melophagus ovinus.*

Guatemala (10): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; S. ramphastonis; Lynchia angustifrons; Olfersia bisulcata; O. sordida; O. coriacea; Lipoptena mazamae.*

British Honduras (8): *Ornithoica vicina; Lynchia angustifrons; Microlynchia furtiva; Olfersia fumipennis; O. bisulcata; O. coriacea; O. spinifera; Stilbometopa podopostyla.*

Republic of Honduras (8): *Ornithoctona erythrocephala; O. nitens; Stilbometopa podopostyla; Lynchia americana; L. nigra; L. albipennis; *Pseudolynchia canariensis; Lipoptena mazamae.*

Nicaragua (4): *Ornithoctona erythrocephala; O. nitens; Lynchia angustifrons; Olfersia bisulcata.*

Costa Rica (13): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; O. nitens; Stilbometopa fulvifrons; S. ramphastonis; Lynchia americana; L. angustifrons; L. wolcotti; L. nigra; L. albipennis; Microlynchia pusilla; M. crypturelli; *Pseudolynchia canariensis; Olfersia bisulcata.*

Panama (21): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; O. nitens; Stilbometopa ramphastonis; Lynchia americana; L. angustifrons; L. wolcotti; L. nigra; L. albipennis; Microlynchia crypturelli; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. aenescens; O. bisulcata; O. fossulata; O. sordida; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Cocos Island (2): *Olfersia aenescens; O. fossulata.*

Antilles. Bahamas (8): *Ornithoica confluenta; Ornithoctona erythrocephala; Stilbometopa fulvifrons; Lynchia albipennis; Olfersia spinifera; O. aenescens; O. fumipennis; O. sordida.* — Cuba and Isle of Pines (10): *Ornithoica*

*vicina; Ornithoctona erythrocephala; Stilbometopa fulvifrons; ?S. ramphastonis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. fumipennis; O. sordida.* — Cayman Islands (1): *Olfersia spinifera.* — Jamaica (9): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa fulvifrons; Lynchia nigra; L. albipennis; *Pseudolynchia canariensis; Olfersia spinifera; O. sordida.* — Hispaniola (5): *Ornithoctona erythrocephala; O. fusciventris; Stilbometopa ramphastonis; *Pseudolynchia canariensis; Olfersia sordida.* — Puerto Rico and Mona Island (6): *Ornithoctona erythrocephala; Lynchia albipennis; *Pseudolynchia canariensis; Olfersia spinifera; O. aenescens; O. fossulata.* — St. Croix (7): *Ornithoctona erythrocephala; Microlynchia pusilla; *Pseudolynchia canariensis; Olfersia spinifera; O. aenescens; O. fossulata; O. sordida.* — St. Thomas (3): *Ornithoctona erythrocephala; Microlynchia pusilla; Olfersia sordida.* — Saba (1): *Ornithoctona erythrocephala.* — St. Kitts (2): *Ornithoctona erythrocephala; *Pseudolynchia canariensis.* — Nevis (1): *Ornithoctona erythrocephala.* — Montserrat (1): *Ornithoctona erythrocephala.* — Guadeloupe (1): *Ornithoctona erythrocephala.* — Marie Galante (1): *Ornithoctona erythrocephala.* — Grenada (2): *Ornithoctona erythrocephala; Microlynchia pusilla.* — Dominica (1): *Ornithoctona erythrocephala.* — St. Vincent (1): *Ornithoctona erythrocephala.* — Grenadines (1): *Ornithoctona erythrocephala.* — Barbados (1): **Pseudolynchia canariensis.*

Colombia (19): *Ornithoica vicina; Ornithomyia ambigua; Crataerina seguyi; Ornithoctona erythrocephala; O. fusciventris; O. oxycera; O. nitens; Stilbometopa podopostyla; Lynchia americana; L. latifacies; L. angustifrons; L. albipennis; L. holoptera; Microlynchia pusilla; *Pseudolynchia canariensis; Olfersia bisulcata; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Venezuela (22): *Ornithoica vicina; O. confluenta; Ornithomyia ambigua; Crataerina seguyi; Myiophthiria neotropica; Ornithoctona erythrocephala; O. fusciventris; O. oxycera; O. nitens; Stilbometopa podopostyla; Lynchia angustifrons; L. wolcotti; L. nigra; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; Olfersia fumipennis;*

*O. bisulcata; O. sordida; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Trinidad (4): **Pseudolynchia canariensis; Olfersia bisulcata; O. sordida; Lipoptena mazamae.*

British Guiana (9): *Stilbometopa podopostyla; Lynchia angustifrons; L. nigra; L. albipennis; L. plaumanni; *Pseudolynchia canariensis; Olfersia bisulcata; O. coriacea; Lipoptena mazamae.*

Dutch Guiana (2): *Olfersia coriacea; Lipoptena mazamae.*

French Guiana (2): (*?Lynchia americana*); *Olfersia bisulcata; Lipoptena mazamae.*

Brazil (30): *Ornithoica vicina; O. confluenta; Ornithomyia ambigua; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; S. ramphastonis; S. legtersi; Lynchia americana; L. latifacies; L. angustifrons; L. wolcotti; L. nigra; L. albipennis; L. holoptera; L. plaumanni; Microlynchia pusilla; M. crypturelli; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. aenescens; O. fumipennis; O. fossulata; O. bisulcata; O. sordida; O. coriacea; Lipoptena mazamae; L. guimaraesi; *Melophagus ovinus.*

Paraguay (7): *Ornithoica vicina; Stilbometopa podopostyla; Lynchia latifacies; L. angustifrons; L. albipennis; Microlynchia pusilla; Lipoptena mazamae.*

Ecuador (8): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; S. ramphastonis; Olfersia fossulata; Lipoptena mazamae; *Melophagus ovinus.*

Peru (13): *Ornithoica vicina; Ornithomyia ambigua; Crataerina seguyi; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; Microlynchia pusilla; *Pseudolynchia canariensis;* (*?Olfersia spinifera*); *O. fossulata; O. bisulcata; O. sordida; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Galapagos (7): *Lynchia nigra; L. albipennis; Microlynchia galapagoensis; Olfersia spinifera; O. aenescens; O. fossulata; O. sordida.*

Bolivia (12): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; Lynchia americana; L. wolcotti; L. nigra; L. plaumanni; Olfersia bisulcata; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Argentina (14): *Ornithomyia parva; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; S. legtersi; Crataerina seguyi; Lynchia americana; L. wolcotti; L. nigra; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Lipoptena mazamae; *Melophagus ovinus.*

Uruguay (4): *Ornithoctona erythrocephala; *Pseudolynchia canariensis; Lipoptena mazamae; *Melophagus ovinus.*

Chile (9): *Ornithoica vicina; Ornithomyia parva; Crataerina seguyi; Ornithoctona erythrocephala; O. fusciventris; Microlynchia pusilla; Olfersia bisulcata; O. fossulata; *Melophagus ovinus.*

Ascension Island (2): *Olfersia spinifera; O. aenescens.*

Tristan da Cunha (2): *Ornithomyia parva; *Melophagus ovinus.*

Gough Island (1): *Ornithomyia parva.*

Falkland Islands (1): **Melophagus ovinus.*

HOST DISTRIBUTION IN AMERICA

I. Birds

The nomenclature and sequence of the Orders are those of J.L. Peters (1931–1951), whose generic, specific and subspecific names I have accepted, so far as published (Orders 1 to 19 of my list and the Furnariidae, Formicariidae and Rhinocryptidae in the Passeriformes). For the remaining families of song-birds I have usually followed the *A.O.U. Check-List* (4th Ed., 1931) of North American birds. For America south of the Mexican border I have consulted particularly R. Ridgway and H. Friedmann, for Middle America (various *Bulletins of the U. S. National Museum,* 11 parts to date, 1901–1950), and C.E. Hellmayr, B. Conover and C.B. Cory's *Catalogue of Birds of the Americas* (11 parts, published by the Field Museum of Natural History, Chicago, 1918–1949). Moreover, I have received much competent advice from my colleagues at the Museum of Comparative Zoology, the late James L. Peters, Mr. James C. Greenway, Dr. R.A. Paynter, Jr., and Mr. Ludlow Griscom. The limits and sequence of the families are those of Mayr and Amadon (1951). For ready reference the genera within the family and the species within the genus are listed in alphabetical order. The names inserted in square brackets are either synonyms previously used in print for hosts of flies or changes proposed for the forthcoming revised edition of the A.O.U. list; the latter are taken from the "Supplements" published in *The Auk* (since 1944).

The hosts are differentiated down to the subspecies, so far as possible, to conform with the prevailing usage among ornithologists. As no case is known at present where the choice of a host by a hippoboscid is influenced by a subspecific difference, the comparative study of host relations may safely disregard subspecific distinctions. The listing of the subspecies is only of interest as showing to what extent the fly covers the geographical range of a host species.

Only vernacular names in actual use are mentioned. They may sometimes be useful for the correct recognition of the hosts; but too often they are applied so carelessly as to be misleading or meaningless. In addition to the standard Anglo-American names of the *A.O.U. Check-List,* I cite occasionally other names in local use. I have been sparing with Central and South American vernaculars, because of their bewildering variety and the difficulty of ascertaining which of them may be actually useful to the collector of flies. Some names are cited merely because they were used in print or on collectors' labels for hippoboscids. The Mexican vernaculars were taken from H. Friedmann, L. Griscom and R.T. Moore's *Distributional Check-List of the Birds of Mexico* (Part I, 1950), or kindly contributed by Dr. R.A. Paynter from his personal notes in Yucatan and Chiapas. The French vernaculars, taken from P.A. Taverner's *Birds of Canada* (Toronto, 1938), are inserted only for birds regularly occurring in the Province of Quebec.

Louse-flies definitely known or reasonably certain to use a given bird as breeding host, are indicated by "(br)"; the others by "(ac)"; hosts introduced by Man within historic times, either directly or indirectly, are marked with an asterisk in this list and elsewhere in the text.

1. Order Tinamiformes

Tinamidae (Tinamous)

Crypturellus boucardi boucardi (P.L. Sclater): *Stilbometopa podopostyla* (br); *Microlynchia furtiva* (br).

Crypturellus obsoletus obsoletus (Temminck); nambú-gauçu in Brazil: *Stilbometopa podopostyla* (br); *Lynchia plaumanni* (?br); *Microlynchia crypturelli* (br).

Crypturellus parvirostris (Wagler); sururina or chororó in Brazil: *Microlynchia crypturelli* (br).

Crypturellus soui panamensis (Carriker): *Ornithoica vicina* (ac); *Microlynchia crypturelli* (br).

Rhynchotus rufescens rufescens (Temminck); perdix or martineta-colorado in Brazil: *Lynchia holoptera* (?ac).

Tinamus solitarius (Vieillot); macuco in Brazil: *Stilbometopa podopostyla* (br); *Olfersia coriacea* (ac).

2. **Order Gaviiformes**

Gaviidae (Loons)

Gavia immer immer (Brünnich); common loon: *Olfersia fumipennis* (ac).

3. **Order Procellariiformes**

Diomedeidae (Albatrosses)

Diomedea irrorata Salvin; Galapagos albatross: *Olfersia aenescens* (br).

4. **Order Pelecaniformes**

Fregatidae (Man-of-war or Frigate Birds)

Fregata aquila (Linnaeus): *Olfersia spinifera* (br).
Fregata magnificens magnificens Mathews: *Olfersia spinifera* (br).
Fregata magnificens rothschildi Mathews; alcatraz in Brazil: *Olfersia spinifera* (br).
Fregata minor ridgwayi Mathews: *Olfersia spinifera* (br).

Phalacrocoracidae (Cormorants)

Phalacrocorax auritus floridanus (Audubon); Florida cormorant: *Olfersia sordida* (br); *Olfersia spinifera* (ac).
Phalacrocorax bougainvillii (Lesson); Peruvian cormorant; guanay: *Olfersia fossulata* (br).
Phalacrocorax gaimardi (Lesson); red-footed cormorant; shag: *Olfersia fossulata* (br).
Phalacrocorax olivaceus olivaceus (Humboldt) [*P. vigua* Vieillot]; shag; biguá in Brazil; corvejón in Mexico: *Olfersia sordida* (br).

Sulidae (Boobies and Gannets)

Sula dactylatra dactylatra Lesson; masked or white-breasted booby: *Olfersia aenescens* (br).
Sula dactylatra californica Rothschild: *Olfersia aenescens* (br).
Sula leucogaster leucogaster (Boddaert); brown booby; *Olfersia aenescens* (br); *Olfersia fossulata* (br).
Sula leucogaster brewsteri Goss; Brewster's brown booby: *Olfersia aenescens* (br).
Sula nebouxii Milne-Edwards: *Olfersia aenescens* (br).
Sula sula sula (Linnaeus); red-footed booby: *Olfersia spinifera* (ac).
Sula sula rubripes Gould; red-footed booby: *Olfersia aenescens* (br).
Sula variegata (Tschudi); Peruvian booby; piquero: *Olfersia fossulata* (br).

Pelecanidae (Pelicans)

Pelecanus occidentalis occidentalis Linnaeus; West Indian brown pelican: *Olfersia sordida* (br).
Pelecanus occidentalis californicus Ridgway; California brown pelican: *Olfersia sordida* (br); *Olfersia fossulata* (br).
Pelecanus occidentalis carolinensis Gmelin; eastern brown pelican: *Olfersia sordida* (br).
Pelecanus occidentalis thagus Molina: *Olfersia fossulata* (br).

5. **Order Ciconiiformes**

Ardeidae (Herons); including Cochleariidae

Ardea cocoi Linnaeus; socó grande, magoarî or garça-parda in Brazil: *Lynchia albipennis* (br).
Ardea herodias herodias Linnaeus: great blue heron: *Lynchia albipennis* (br).
Ardea herodias cognata Bangs: *Lynchia albipennis* (br).

Ardea herodias occidentalis Audubon; great white heron (white phase of great blue heron): *Lynchia albipennis* (br).
Ardea herodias sanctilucae Thayer and Bangs; Espiritu Santo heron: *Lynchia albipennis* (br).
Botaurus lentiginosus (Rackett); American bittern; butor d'Amérique; atepo-naztli or toleomoctli (Náhuatl) in Mexico: *Ornithoctona erythrocephala* (ae); *Lynchia albipennis* (br).
**Bubulcus ibis ibis* (Linnaeus); cattle heron: *Ornithoica confluenta* (br).
Butorides sundevalli Reichenow: *Lynchia albipennis* (br).
Butorides virescens virescens (Linnaeus); eastern green heron: *Ornithoica vicina* (ae); *Lynchia albipennis* (br).
Butorides virescens bahamensis (Brewster): *Ornithoica confluenta* (br); *Lynchia albipennis* (br).
Butorides virescens maculatus (Boddaert): *Ornithoctona erythrocephala* (ae); *Lynchia albipennnis* (br).
Casmerodius albus egretta (Gmelin); American egret; garça-real or acaratinga in Brazil: *Ornithoica confluenta* (br); *Lynchia americana* (ae); *Lynchia albipennis* (br).
Cochlearius cochlearius cochlearius (Linnaeus); boatbill; arapapá in Brazil; papaxque (Náhuatl) in Mexico: *Lynchia albipennis* (br).
Cochlearius cochlearius panamensis Griscom: *Lynchia albipennis* (br).
Dichromanassa rufescens rufescens (Gmelin); reddish egret: *Lynchia albipennis* (br).
Florida caerulea caerulea (Linnaeus); little blue heron; garça-azul in Brazil; axoquen (Náhuatl) in Mexico: *Lynchia albipennis* (br).
Hydranassa tricolor ruficollis (Gosse); Louisiana heron: *Lynchia albipennis* (br).
Ixobrychus exilis exilis (Gmelin); eastern least bittern: *Lynchia albipennis* (br).
Leucophoyx thula thula (Molina) [*Ardea candidissima* Gmelin]; snowy egret; garça-pequena in Brazil; aztatl (Náhuatl) in Mexico: *Ornithoica confluenta* (br); *Ornithoctona erythrocephala* (ae); *Lynchia albipennis* (br); *Olfersia sordida* (ae).
Mesembrinibis cayennensis (Gmelin); caráuna in Brazil: *Lynchia albipennis* (br); *Olfersia coriacea* (ae).
Nyctanassa violacea violacea (Linnaeus); yellow-crowned night heron: *Ornithoctona erythrocephala* (ae); *Lynchia albipennis* (br).
Nyctanassa violacea pauper (Selater and Salvin): *Lynchia albipennis* (br).
Nycticorax nycticorax hoactli (Gmelin) [*N. n. naevius* Boddaert]; black-crowned night heron; savací, guacurú or socó-galinha in Brazil; hoactli (Náhuatl) in Mexico: *Ornithoctona erythrocephala* (ae); *Lynchia albipennis* (br).
Syrigma sibilatrix (Temminck): *Lynchia albipennis* (br).
Tigrisoma lineatum marmoratum (Vieillot); socó-boi in Brazil: *Lynchia albipennis* (br).

Threskiornithidae (Ibises)

Guara [now *Eudocimus*] *alba* (Linnaeus); white ibis: *Lynchia albipennis* (br).
Theristicus caudatus (Boddaert); curicaca in Brazil: *Lynchia albipennis* (br).

Ciconiidae (Storks)

Jabiru mycteria (Lichtenstein); jaburú: *Lynchia albipennis* (br).
Mycteria americana Linnaeus; wood ibis; Jaburú-moleque in Brazil; coyongo or ganso in Colombia; cuapetlauac or cuapetlanqui (Náhuatl) in Mexico: *Lynchia albipennis* (br).

6. Order Anseriformes

Anatidae (Ducks, Geese)

Anas brasiliensis Gmelin [*Nettion brasiliense*]; marreca-ananaî in Brazil: *Lynchia albipennis* (ae).

Anas crecca carolinensis Gmelin; green-winged teal: *Lynchia albipennis* (ae).

Branta canadensis canadensis (Linnaeus); common Canada goose; outarde canadienne: *Ornithoctona erythrocephala* (ae).

7. Order Falconiformes

Accipitridae (Hawks, Eagles)

Accipiter bicolor bicolor (Vieillot); bicolored hawk: *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (br).

Accipiter bicolor pileatus (Temminck): *Lynchia nigra* (br).

Accipiter cooperii (Bonaparte); Cooper's hawk: *Ornithoica vicina* (ae); *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (br); *Stilbometopa impressa* (ae); *Lynchia americana* (br); *Lynchia angustifrons* (br).

Accipiter erythrocnemius chionogaster (Kaup); Guatemalan sharp-shinned hawk: *Ornithoctona erythrocephala* (br).

Accipiter erythrocnemius salvini (Ridgway): *Ornithoctona erythrocephala* (br).

Accipiter erythrocnemius venezuelensis Swann: *Ornithoctona erythrocephala* (br).

Accipiter erythrocnemius ventralis Sclater: *Ornithoctona fusciventris* (ae).

Accipiter gentilis atricapillus (Wilson); eastern goshawk: *Ornithoctona erythrocephala* (br); *Lynchia americana* (br).

Accipiter gundlachi Lawrence: *Ornithoctona erythrocephala* (br).

Accipiter striatus velox (Wilson); sharp-shinned hawk; épervier brun: *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (br); *Ornithoctona fusciventris* (ae); *Lynchia americana* (br); *Lynchia wolcotti* (br); *Lynchia nigra* (br); *Lynchia albipennis* (ae); *Lynchia augustifrons* (br); *Neolipoptena ferrisi* (ae).

Aquila chrysaëtos canadensis (Linnaeus); American golden eagle; aigle doré; itzcuauhtli (Náhuatl) in Mexico: *Lynchia americana* (br); *Lynchia nigra* (br).

Busarellus nigricollis nigricollis (Latham); fishing buzzard; guaraguao in Mexico: *Ornithoica vicina* (ae); *Lynchia angustifrons* (br).

Buteo brachyurus Vieillot: *Ornithoctona erythrocephala* (br).

Buteo galapagoensis (Gould); Galapagos hawk: *Lynchia nigra* (br); *Microlynchia galapagoensis* (?ae).

Buteo jamaicensis jamaicensis (Gmelin); West Indian red-tailed hawk: *Ornithoctona erythrocephala* (br).

Buteo jamaicensis borealis (Gmelin); eastern red-tailed hawk; buse à queue rousse: *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia nigra* (br).

Buteo jamaicensis calurus Cassin; western red-tailed hawk; chiseny (Otomî) in Mexico: *Ornithoica vicina* (ae); *Lynchia nigra* (br).

Buteo jamaicensis costaricensis Ridgway: *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br).

Buteo jamaicensis umbrinus Bangs: *Ornithoctona erythrocephala* (br).

Buteo lagopus sancti-johannis (Gmelin); American rough-legged hawk; buse pattue: *Lynchia americana* (br).

Buteo lineatus lineatus (Gmelin); northern red-shouldered hawk; buse à épaulettes rousses: *Lynchia americana* (br); *Lynchia angustifrons* (br).

Buteo lineatus alleni Ridgway; Florida red-shouldered hawk: *Lynchia americana* (br).

Buteo magnirostris magnirostris (Gmelin) [*B. m. magniplumis* Bertoni]; insect hawk; indaié, japacanim, or gavião-carijó in Brazil: *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br); *Lynchia americana* (ae); *Lynchia angustifrons* (br).

Buteo magnirostris argutus (Peters and Griscom): *Ornithoctona erythrocephala* (br).

Buteo magnirostris conspectus (Peters); *Lynchia nigra* (br).

Buteo magnirostris gularis (Schlegel): *Ornithoctona erythrocephala* (br).

Buteo magnirostris insidiatrix (Bangs and Penard): *Ornithoctona erythrocephala* (br).

Buteo magnirostris superciliaris (Vieillot): *Lynchia nigra* (br).

Buteo melanoleucus melanoleucus (Vieillot): aguia-chilena in Brazil; guincho in Mexico: *Ornithoctona erythrocephala* (br); *Ornithoctona oxycera* (?br).

Buteo nitidus micrus (Griscom): *Lynchia nigra* (br).

Buteo nitidus pallidus Todd: *Lynchia nigra* (br).

Buteo nitidus plagiatus (Schlegel); Mexican gray hawk: *Oruithomyia* (*Pseudornithomyia*) *hoffmannae* (?ae); *Lynchia nigra* (br).

Buteo platypterus platypterus (Vieillot); broad-winged hawk; petite buse or buse de Pennsylvanie: *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia wolcotti* (br); *Lynchia angustifrons* (br).

Buteo platypterus antillarum Clark: *Ornithoctona erythrocephala* (br).

Buteo platypterus cubanensis Burns [*B. latissimus* of Cuba]: *Ornithoctona erythrocephala* (br).

Buteo platypterus rivieri Verrill: *Ornithoctona erythrocephala* (br).

Buteo swainsoni Bonaparte; Swainson's hawk: *Lynchia nigra* (br).

Buteogallus anthracinus anthracinus (Lichtenstein); Mexican crab hawk; mixcoacuahtli (Náhuatl) in Mexico: *Lynchia nigra* (br).

Buteogallus anthracinus cancrivorus (Clark); black hawk of St. Vincent: *Ornithoctona erythrocephala* (br).

Chondrohierax uncinatus (Temminck): *Ornithoctona erythrocephala* (br).

Circus cinereus Vieillot: *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (br).

Circus cyaneus hudsonius (Linnaeus); marsh hawk; busard des marais; tlocuauhtli or tlacocuauhtli in Mexico: *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia nigra* (br).

Elanoides forficatus yetapa (Vieillot); gavião-tesoura or tapena in Brazil: *Ornithoctona erythrocephala* (br).

Elanus leucurus leucurus (Vieillot); white-tailed kite; gavião-peneira in Brazil: *Lynchia angustifrons* (br).

Gampsonyx swainsonii swainsonii Vigors; pearl kite: *Lynchia nigra* (br).

Geranospiza nigra nigra (Du Bus); black frog hawk: *Lynchia nigra* (br).

Haliaeëtus leucocephalus leucocephalus (Linnaeus); southern bald eagle: *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Olfersia fumipennis* (ae).

Heterospizias meridionalis meridionalis (Latham); gavião-caboclo in Brazil: *Lynchia nigra* (br).

Hypomorphnus urubitinga urubitinga (Gmelin); gavião-preto, cauá or cãcã in Brazil: *Ornithoica vicina* (ae); *Lynchia angustifrons* (br).

Hypomorphnus urubitinga ridgwayi (Gurney): *Ornithoctona erythrocephala* (br); *Lynchia wolcotti* (br); *Lynchia angustifrons* (br).

Ictinia plumbea (Gmelin); ota-azul in Colombia; gavião-sauveiro or soví in Brazil: *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (br); *Lynchia nigra* (br).

Leucopternis albicollis costaricensis W.L. Sclater: *Lynchia americana* (ae); *Lynchia angustifrons* (br).

Leucopternis polionota Kaup; gavião-pomba in Brazil: *Lynchia nigra* (br).
Leucopternis princeps Sclater: *Ornithoctona erythrocephala* (br).
Odontriorchis palliatus (Temminck): *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (br).
Oroaëtus isidori (Des Murs): *Ornithoctona erythrocephala* (br).
Spizaëtus ornatus (Daudin); apacanim or urutaurana in Brazil; juandeapié in Mexico: *Ornithoctona erythrocephala* (br).
Spizaëtus tyrannus (Wied); tyrant eagle hawk: *Ornithoctona erythrocephala* (br).
Urubitornis solitaria solitaria (Tschudi); southern solitary eagle: *Ornithoctona erythrocephala* (br); *Lynchia wolcotti* (br).

Falconidae (Falcons and Allies)

Caracara [formerly *Polyborus*] *cheriway audubonì* Cassin; Audubon's caracara; quebrantahuesos or qualele in Mexico: *Lynchia nigra* (br).
Caracara [formerly *Polyborus*] *plancus plancus* (J.F. Miller): *Ornithomyia parva* (ac); *Lynchia americana* (ac).
Caracara [formerly *Polyborus*] *plancus brasiliensis* (Gmelin); caracará or carancho in Brazil: *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br).
Daptrius americanus americanus (Boddaert); South American carrion falcon; comecacao in Spanish-American countries: *Ornithoctona erythrocephala* (br).
Daptrius ater Vieillot: *Lynchia nigra* (br).
Falco columbarius columbarius Linnaeus; eastern pigeon hawk; faucon émérillon: *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia nigra* (br).
Falco columbarius bendirei Swann; western pigeon hawk: *Ornithomyia fringillina* (ac).
Falco deiroleucus Temminck; Temminck's falcon: *Ornithoctona erythrocephala* (br).
Falco femoralis femoralis Temminck (= *Falco fusco-coerulescens* of authors, not of Vieillot); southern Aplomado falcon; gavião-de-coleira in Brazil: *Ornithoctona erythrocephala* (br).
Falco mexicanus Schlegel; prairie falcon; thotli (Náhuatl) in Mexico: *Lynchia nigra* (br).
Falco peregrinus anatum Bonaparte; peregrine falcon or duck hawk; faucon pélerin: *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia nigra* (br).
Falco sparverius sparverius Linnaeus; eastern sparrow hawk; faucon cresserelle; chia (Mixteco) or titicha (Otomí) in Mexico: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br); *Lynchia angustifrons* (br); *Lynchia albipennis* (ac).
Falco sparverius caribaeorum (Gmelin): *Ornithoctona erythrocephala* (br).
Falco sparverius cinnamominus Swainson: *Lynchia americana* (br).
Falco sparverius dominicensis (Gmelin): *Ornithoctona erythrocephala* (br).
Falco sparverius eidos Peters: *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br).
Falco sparverius loquaculus Riley: *Ornithoctona erythrocephala* (br).
Falco sparverius peruvianus (Cory): *Ornithoctona erythrocephala* (br).
Herpetotheres cachinnans cachinnans (Linnaeus); southern laughing falcon; acauã in Brazil; guacabó in Colombia: *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br).
Herpetotheres cachinnans chapmani Bangs and Penard: *Lynchia nigra* (br); *Lynchia angustifrons* (br).
Herpetotheres cachinnans queribundus Bangs and Penard: *Lynchia nigra* (br).

Micrastur gilvicollis (Vieillot): *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br).
Micrastur ruficollis ruficollis (Vieillot); gavião-caboré in Brazil: *Ornithoica vicina* (ae); *Lynchia americana* (ae); *Lynchia angustifrons* (br).
Micrastur ruficollis zonothorax (Cabanis): *Ornithoctona erythrocephala* (br).
Micrastur semitorquatus naso (Lesson); Central American pied forest falcon: *Ornithoctona erythrocephala* (br); *O. fusciventris* (ae); *Lynchia wolcotti* (br); *Lynchia angustifrons* (br).
Milvago chimachima chimachima (Vieillot); chimango-do-campo in Brazil: *Lynchia nigra* (br); *Lynchia angustifrons* (br).

Pandionidae (Ospreys)

Pandion haliaetus carolinensis (Gmelin); American fishhawk or osprey; aigle-pêcheur or orfraie; gavião-caripira in Brazil: *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (ae); *Lynchia americana* (ae); *Lynchia albipennis* (ae); *Olfersia fumipennis* (br).
Pandion haliaetus ridgwayi Mainard; Bahamas osprey: *Olfersia fumipennis* (br).

Cathartidae (New World Vultures)

Cathartes aura aura (Linnaeus); Central American turkey vulture, turkey buzzard, or red-headed vulture: *Lynchia nigra* (ae); *Lynchia angustifrons* (ae); *Olfersia bisulcata* (br).
Cathartes aura jota (Molina): *Ornithoctona erythrocephala* (ae); *Olfersia bisulcata* (br).
Cathartes aura ruficollis Spix; urubú-de-cabeça-vermelha in Brazil: *Lynchia nigra* (ae); *Olfersia bisulcata* (br).
Cathartes aura teter Friedmann; western turkey vulture: *Ornithomyia fringillina* (ae).
Cathartes urubutinga Pelzeln; urubitinga in Brazil: *Olfersia bisulcata* (?br).
Coragyps atratus atratus (Bechstein) [*Catharista urubu* Vieillot]; North and Central American black-headed vulture, black vulture or buzzard; tzopilotl (Náhuatl), lonchi (Mixteco), or zapilote-de-campo in Mexico: *Olfersia bisulcata* (br).
Coragyps atratus foetens (Lichtenstein) [*Catharista brasiliensis* Bonaparte]; South American black vulture; urubú in Brazil; gallinazo, golero, or chulo in Spanish America; cuervo or jote in Argentina; some ornithologists unite this with typical *atratus: Ornithoctona erythrocephala* (ae); *Olfersia bisulcata* (br).
Sarcoramphus papa (Linnaeus); king vulture; rey-de-chombo or cozcacuauhtli (Náhuatl) in Mexico; alguacil or rey-de-goleros in Colombia; urubú-rei in Brazil: *Olfersia bisulcata* (br).
Vultur gryphus Linnaeus; condor: *Olfersia bisulcata* (?br).

8. Order Galliformes

Cracidae (Guans)

Chamaepetes goudotii goudotii (Lesson): *Ornithoctona erythrocephala* (br).
Chamaepetes goudotii sanctae-marthae Chapman: *Ornithoctona fusciventris* (ae).
Crax alberti alberti Fraser [*C. annulata* Todd]; pajuil in Colombia: *Olfersia coriacea* (br).
Crax fasciolata Spix [*C. sclateri* G.R. Gray]: *Olfersia coriacea* (br).
Crax nigra Linnaeus [*C. alector* Linnaeus]; mutum-poranga in Brazil: *Lynchia plaumanni* (?br); *Olfersia coriacea* (br).
Crax rubra rubra Linnaeus [? *C. globicera* Linnaeus]; crested curassow; kambul (Maya) or boloncha in Mexico: *Olfersia coriacea* (br).

Ortalis canicollis canicollis (Wagler); charata in Argentina: *Stilbometopa legtersi* (?br); possibly also type host of the unrecognized *Lynchia penelopes.*

Ortalis canicollis pantanalensis Cherrie and Reichenberger; aracuá in Brazil: *Stilbometopa ramphastonis* (?br).

Ortalis columbiana caucae Chapman: *Ornithoctona erythrocephala* (br).

Ortalis vetula vetula (Wagler), chachalaca: *Ornithoctona erythrocephala* (br); *Lynchia plaumanni* (?br).

Ortalis vetula pallidiventris Ridgway; chachalaca; chacha, bach (Maya), or chachalacametl (Náhuatl) in Mexico: *Olfersia coriacea* (br).

Ortalis vetula poliocephala (Wagler), chachalaca: *Stilbometopa legtersi* (?br).

Penelope argyrotis argyrotis (Bonaparte): *Ornithoctona erythrocephala* (br).

Penelope argyrotis colombiana Todd: *Ornithoctona erythrocephala* (br).

Penelope montagnii montagnii (Bonaparte): *Ornithoctona erythrocephala* (br).

Penelope purpurascens purpurascens Wagler; bare-throated guan; kosh (Maya) or cojolito in Mexico: *Ornithoctona erythrocephala* (br); *Olfersia coriacea* (br).

Penelopina nigra (Fraser); pajuil in Mexico: *Ornithoctona erythrocephala* (br).

Pipile jacutinga (Spix); jacutinga in Brazil: *Stilbometopa ramphastonis* (br).

Phasianidae (Pheasants, Quail, Fowl); including Tetraonidae

Bonasa umbellus umbellus (Linnaeus); eastern ruffed grouse: *Ornithomyia fringillina* (br); *Lynchia americana* (br).

Bonasa umbellus togata (Linnaeus); Canada ruffed grouse; gélinotte des bois francs: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (br); *Lynchia americana* (br).

Bonasa umbellus umbelloides (Douglas); gray ruffed grouse: *Ornithomyia fringillina* (br).

Bonasa umbellus yukonensis Grinnell; Yukon ruffed grouse: *Ornithomyia fringillina* (br).

Callipepla squamata pallida Brewster; Arizona scaled quail: *Stilbometopa impressa* (?ac); *Microlynchia pusilla* (ac).

Canachites canadensis canadensis (Linnaeus); Hudsonian spruce grouse; tétras des savannes: *Ornithomyia fringillina* (br).

Canachites franklinii (Douglas); Franklin's grouse: *Ornithomyia fringillina* (br).

Centrocercus urophasianus (Bonaparte); sage hen or sage grouse: *Lynchia hirsuta* (br).

Colinus cristatus sonnini (Temminck): *Microlynchia pusilla* (br).

Colinus virginianus virginianus (Linnaeus); eastern partridge, quail or bobwhite: *Ornithomyia fringillina* (ac); *Lynchia americana* (br); *Microlynchia pusilla* (br); [*Stilbometopa fulvifrons,* on introduced birds in Jamaica].

Dactylortyx thoracicus thoracicus (Gambel): *Ornithoctona erythrocephala* (?br).

Dendragapus obscurus obscurus (Say); dusky grouse: *Ornithomyia fringillina* (br).

Dendragapus obscurus fuliginosus (Ridgway); sooty grouse or willow grouse: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (br).

Dendragapus obscurus richardsoni (Douglas); blue grouse, Richardson's grouse: *Ornithomyia fringillina* (br); *Lynchia hirsuta* (br).

**Gallus gallus bankiva* Temminck; domestic fowl: *Ornithoica vicina* (ac); *Stilbometopa podopostyla* (ac); *Stilbometopa impressa* (ac); *Lynchia americana* (ac); *Pseudolynchia canariensis* (ac; introduced).

Lagopus lagopus lagopus (Linnaeus) [including *Tetrao albus* Gmelin]; willow ptarmigan or willow grouse; lagopède des saules; (circumpolar): *Ornithomyia fringillina* (br).

Lophortyx californica californica Shaw [*L. c. vallicola* Ridgway]; California quail: *Stilbometopa impressa* (br); *Lynchia hirsuta* (br).
Lophortyx californica brunnescens Ridgway: *Stilbometopa impressa* (br); *Lynchia hirsuta* (br).
Lophortyx douglasii bensoni (Ridgway); elegant quail: *Stilbometopa impressa* (br).
Lophortyx gambelii gambelii Gambel; Gambel's quail: *Ornithoica vicina* (ae); *Stilbometopa impressa* (br); [*Lynchia hirsuta;* in captivity only]; *Microlynchia pusilla* (br).
Odontophorus capueira capueira (Spix); capoeira in Brazil: *Lynchia plaumanni* (?br).
Odontophorus guttatus veraguensis Gould: *Ornithoctona erythrocephala* (?br).
Odontophorus hyperethrus Gould: *Ornithoctona erythrocephala* (?br).
Odontophorus strophium (Gould): *Ornithoctona erythrocephala* (?br).
Oreortyx picta picta (Douglas) [*O. p. plumifera* Gould]; plumed quail: *Stilbometopa impressa* (?br); *Lynchia hirsuta* (?br).
Pediocectes phasianellus campestris Ridgway; prairie sharp-tailed grouse; gélinote à queue fine: *Lynchia americana* (?ae).
**Phasianus colchicus* Linnaeus; ring-necked pheasant (a mixture of two or more subspecies in North America): *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (ae); *Lynchia americana* (ae).

Meleagridae (Turkeys)

Agriocharis ocellata (Cuvier); ocellated turkey; pavo-del-monte, pavo silvestre, or kutz (Maya) in Mexico: *Olfersia coriacea* (?br).
Meleagris gallopavo gallopavo Linnaeus; domestic turkey; perú in Brazil; guajalote in Mexico: *Stilbometopa podopostyla* (ae); *Olfersia coriacea* (ae).
Meleagris gallopavo silvestris Vieillot; eastern wild turkey: *Lynchia americana* (br).

9. Order Gruiformes

Eurypygidae (Sun Bitterns)

Eurypyga helias major Hartlaub: *Ornithoctona erythrocephala* (?ae).

Rallidae (Rails)

Aramides saracura (Spix); saracura: *Lynchia holoptera* (br).
Atlantisia rogersi Lowe; Tristan da Cunha flightless rail: *Ornithomyia parva* (br).
Coturnicops noveboracensis (Gmelin); yellow rail; râle jaune: *Lynchia holoptera* (br).
Gallinula chloropus cachinnans Bangs; Florida gallinule: *Lynchia albipennis* (ae).
Porphyriornis comeri Allen: *Ornithomyia parva* (br).
Porphyrula martinica (Linnaeus); cuatezcatl (Náhuatl) in Mexico: *Lynchia albipennis* (ae).
Porzana carolina (Linnaeus); sora; râle ortolan: *Lynchia albipennis* (ae).
Rallus limicola limicola Vieillot; Virginia rail: *Lynchia holoptera* (br).

10. Order Charadriiformes

Charadriidae (Plovers, Sandpipers); including Scolopacidae, Recurvirostridae and Phalaropodidae

Capella nobilis (Selater): *Lynchia angustifrons* (ae).
Philohela minor (Gmelin); American woodcock; bécasse: *Ornithomyia fringillina* (ae); *Lynchia americana* (?ae).

Tringa melanoleuca (Gmelin); greater yellow-legs; grand chevalier à pattes jaunes: *Lynchia albipennis* (ac).

Laridae (Gulls, Terns, Skuas); including Stercorariidae and Rhynchopidae

Anoüs stolidus stolidus (Linnaeus); noddy tern: *Olfersia aenescens* (br).
Larosterna inca (Lesson); Inca tern: *Olfersia fossulata* (?br).
Larus belcheri Vigors; Belcher's gull: *Olfersia fossulata* (?br).
Larus delawarensis Ord; ring-billed gull: *Ornithomyia fringillina* (ac).
Larus fuliginosus Gould; dusky or lava gull: *Lynchia albipennis* (ac).
Sterna sp.: *Lynchia americana* (ac).
Sterna anaethetus melanoptera Swainson; bridled tern: *Olfersia aenescens* (?ac).
Sterna fuscata crissalis (Lawrence); American sooty tern: *Olfersia aenescens* (?ac).

Alcidae (Auks)

Uria lomvia lomvia (Linnaeus); Brünnich's murre: *Lynchia americana* (ac).

11. Order Columbiformes

Columbidae (Pigeons)

Claravis godefrida Temminck [*Peristera geoffroyi* Temminck]; pomba-espelho or pararú in Brazil: *Ornithoctona erythrocephala* (br).
Columba albilinea albilinea Bonaparte: *Ornithoctona erythrocephala* (br).
Columba inornata inornata Vigors: *Ornithoctona erythrocephala* (br).
Columba leucocephala Linnaeus; white-crowned pigeon: *Ornithoctona erythrocephala* (br); *Stilbometopa fulvifrons* (br); *Microlynchia pusilla* (br).
**Columba livia livia* Gmelin; domestic pigeon: *Ornithoctona erythrocephala* (ac); *Stilbometopa podopostyla* (ac); *Microlynchia pusilla* (ac); *Pseudolynchia canariensis* (br; introduced).
Columba picazuro picazuro Temminck; pomba-trocal in Brazil: *Ornithoctona erythrocephala* (br).
Columba (*?rufina pallidicrissa* Chubb): *Stilbometopa ramphastonis* (?ac); *Microlynchia pusilla* (br).
Columba rufina sylvestris Vieillot; pomba-verdadeira in Brazil: *Stilbometopa podopostyla* (br); *Lynchia americana* (ac); *Microlynchia crypturelli* (?ac); *Ornithoctona erythrocephala* (br).
Columba speciosa Gmelin; scaly-necked dove: *Stilbometopa podopostyla* (br).
Columba squamosa Bonnaterre: *Ornithoctona erythrocephala* (br).
Columba subvinacea bogotensis (Berlepsch and Leverkühn): *Ornithoctona erythrocephala* (br).
Columbigallina cruziana (Prévost): *Microlynchia pusilla* (br).
Columbigallina passerina nigrirostris Danforth: *Microlynchia pusilla* (br).
Columbigallina passerina portoricensis (Lowe): *Ornithoctona erythrocephala* (br).
Columbigallina talpacoti talpacoti (Temminck and Knip): *Microlynchia pusilla* (br); [*?*Pseudolynchia canariensis* (ac)].
Geotrygon versicolor (Lafresnaye) [*Geotrygon sylvatica* Gosse]: *Ornithoctona erythrocephala* (br); *Stilbometopa fulvifrons* (br).
Leptotila jamaicensis jamaicensis (Linnaeus): *Ornithoctona erythrocephala* (br).
Leptotila plumbeiceps plumbeiceps (Sclater and Salvin): *Ornithoctona fusciventris* (ac).
Leptotila rufaxilla reichenbachii Pelzeln; jurutí in Brazil: *Ornithomyia* (*Pseudornithomyia*) *ambigua* (?ac); *Microlynchia pusilla* (br).
Leptotila verreauxi verreauxi (Bonaparte); torcaza in Spanish America: *Ornithoctona erythrocephala* (br); *Stilbometopa podopostyla* (br).

Leptotila verreauxi chalcauchenia (Sclater and Salvin): *Stilbometopa podopostyla* (br).
Leptotila verreauxi decipiens (Salvadori) [*L. v. ochroptera* Pelzeln]: *Stilbometopa podopostyla* (br).
Leptotila verreauxi fulviventris (Lawrence); tsutsuy (Maya) in Mexico: *Stilbometopa podopostyla* (br).
Metropelia ceciliae ceciliae (Lesson): *Microlynchia pusilla* (br).
Nesopelia galapagoensis (Gould): *Microlynchia galapagoensis* (?br).
Oreopelcia [now *Geotrygon*] *bourcieri frenata* (Tschudi): *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *caniceps leucometopius* Chapman: *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *chrysia* (Bonaparte): *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *linearis infusca* (Bangs): *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *montana montana* (Linnaeus); ruddy quail dove: *Ornithoctona erythrocephala* (br); *Ornithoctona* (*Ornithopertha*) *nitens* (?br); *Stilbometopa fulvifrons* (br).
Oreopeleia [now *Geotrygon*] *mystacea beattyi* Danforth: *Microlynchia pusilla* (br).
Oreopeleia [now *Geotrygon*] *mystacea sabae* (Riley): *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *violacea albiventer* (Lawrence): *Ornithoctona erythrocephala* (br).
Scardafella inca (Lesson); Inca dove; cocotli (Náhuatl), lucu (Mixteco), or joño (Otomí) in Mexico: *Microlynchia pusilla* (br).
Scardafella squammata squammata (Lesson) [*Columba squamosa* Temminck, not of Bonaterre]; rolinha-cascaval or fogo-apagou in Brazil: *Stilbometopa podopostyla* (br); *Microlynchia pusilla* (br).
**Streptopelia chinensis chinensis* (Scopoli); Chinese spotted dove: *Microlynchia pusilla* (ae).
Zenaida asiatica asiatica (Linnaeus) [*Melopelia leucoptera* Linnaeus]; white-winged dove; sakpakal (Maya) in Mexico: *Ornithoctona erythrocephala* (br); *Stilbometopa podopostyla* (br); *Microlynchia pusilla* (br).
Zenaida asiatica mearnsi (Ridgway): *Microlynchia pusilla* (br).
Zenaida asiatica meloda (Tschudi): *Ornithoctona erythrocephala* (br).
Zenaida aurita aurita (Temminck): *Ornithoctona erythrocephala* (br).
Zenaida aurita zenaida (Bonaparte) [*Zenaida amabilis* Bonaparte]; zenaida dove: *Ornithoctona erythrocephala* (br).
Zenaidura auriculata hypoleuca (Bonaparte): *Ornithoctona erythrocephala* (br).
Zenaidura auriculata rubripes (Lawrence): *Microlynchia pusilla* (br).
Zenaidura macroura macroura (Linnaeus); West Indian mourning dove: *Ornithoctona erythrocephala* (br).
Zenaidura macroura carolinensis (Linnaeus); eastern mourning dove; tourterelle triste: *Stilbometopa podopostyla* (br); *Lynchia americana* (ae); *Microlynchia pusilla* (br).
Zenaidura macroura clarionensis C. H. Townsend: *Microlynchia pusilla* (br).
Zenaidura macroura marginella (Woodhouse); western mourning dove; huilota or uilotl (Náhuatl) in Mexico: *Stilbometopa podopostyla* (br); *Microlynchia pusilla* (br).

12. **Order Psittaciformes**

Psittacidae (Parrots)

Amazona aestiva xanthopteryx (Berlepsch): *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (ae).

Amazona collaris (Linnaeus); yellow-billed parrot: *Ornithoica vicina* (ac).
Amazona guildingii (Vigors): *Ornithoctona erythrocephala* (br).
Amazona leucocephala leucocephala (Linnaeus): *Ornithoica vicina* (ac); *Ornithoctona erythrocephala* (br).
Amazona ventralis (P.L.S. Müller): *Ornithoctona erythrocephala* (br).
Amazona vinacea (Kuhl); jurueba in Brazil: *Ornithoctona erythrocephala* (br).
Aratinga nana (Vigors): *Ornithoctona erythrocephala* (br).
Pionus sordidus saturatus Todd: *Ornithoctona erythrocephala* (br).
Pionus tumultuosus (Tschudi): *Ornithoctona erythrocephala* (br).

13. **Order Cuculiformes**

Cuculidae (Cuckoos)

Geococcyx californianus (Lesson); roadrunner; chaparral cock: *Microlynchia pusilla* (br).
Piaya cayana macroura Gambel; alma-de-caboclo or tinguaçú in Brazil: *Ornithoica vicina* (ac); *Lynchia latifacies* (?br).
Piaya cayana mehleri Bonaparte [*P. c. columbiana* Cabanis]: *Ornithoctona erythrocephala* (ac).
Piaya cayana nigricrissa (Cabanis): *Lynchia latifacies* (?br).
Piaya cayana pallescens (Cabanis and Heyne): *Lynchia nigra* (ac).
Saurothera vetula vetula (Linnaeus): *Ornithoctona erythrocephala* (ac); *Stilbometopa fulvifrons* (ac).
Saurothera vetula vieilloti Bonaparte: *Ornithoctona erythrocephala* (ac).

14. **Order Strigiformes**

Strigidae (Owls); including Tytonidae

Aegolius [formerly *Cryptoglaux*] *acadicus acadicus* (Gmelin); saw-whet owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Asio flammeus flammeus (Pontoppidan); short-eared owl; hibou à oreilles courtes: *Ornithoica vicina* (br).
Asio flammeus portoricensis Ridgway: *Ornithoctona erythrocephala* (?ac).
Asio flammeus suinda (Vieillot) [*A. f. breviauris* Schlegel]: *Ornithoctona erythrocephala* (?ac); *Lynchia wolcotti* (?ac).
Asio stygius siguapa (d'Orbigny): *Ornithoctona erythrocephala* (?ac).
Asio wilsonianus (Lesson); long-eared owl; hibou à oreilles longues: *Ornithoica vicina* (br); *Ornithomyia fringillina* (ac); *Lynchia americana* (br).
Bubo virginianus virginianus (Gmelin); great horned owl or long-eared owl; duc de Virginie or grand-duc: *Ornithoica vicina* (br); *Ornithomyia fringillina* (ac); *Lynchia americana* (br).
Bubo virginianus mayensis Nelson: *Lynchia americana* (br).
Bubo virginianus pacificus Cassin; Pacific horned owl: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lipoptena depressa* (ac); *Neolipoptena ferrisi* (ac).
Bubo virginianus pallescens Stone; western horned owl: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lynchia nigra* (ac).
Bubo virginianus saturatus Ridgway; dusky horned owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Bubo virginianus wapacuthu (Gmelin) [*B. v. subarcticus* Hoy]; arctic horned owl: *Lynchia americana* (br).
Ciccaba virgata virgata (Cassin): *Ornithoica vicina* (br).
Ciccaba virgata borelliana (Bertoni): *Ornithoica vicina* (br); *Lynchia americana* (br).
Ciccaba virgata centralis Griscom: *Lynchia wolcotti* (?ac); *Lynchia angustifrons* (ac).
Glaucidium brasilianum brasilianum (Gmelin); caninde in Brazil: *Lynchia americana* (br); *Lynchia angustifrons* (ac).

Glaucidium brasilianum phaloenoides (Daudin): *Lynchia wolcotti* (?ae).
Glaucidium brasilianum ridgwayi Sharpe: *Ornithoica vicina* (br); *Lynchia angustifrons* (ae).
Glaucidium gnoma californicum Selater; California pygmy owl: *Ornithomyia fringillina* (ae).
Glaucidium nanum (King); chuncho in Chile: *Ornithomyia parva* (ae).
Glaucidium siju (d'Orbigny): *Ornithoctona erythrocephala* (?ae).
[*?Lophostrix cristata stricklandi* Selater and Salvin): *Lynchia wolcotti* (?ae)].
Otus albogularis albogularis (Cassin): *Ornithoica vicina* (br).
Otus asio asio (Linnaeus); southern screech owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Otus asio bendirei (Brewster); California screech owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Otus asio brewsteri Ridgway; Brewster's screech owl: *Lynchia americana* (br).
Otus asio floridanus (Ridgway); Florida screech owl: *Lynchia americana* (br).
Otus asio kennicottii (Elliot) [*O. a. saturatus*]; Kennicott's screech owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Otus asio mecallii (Cassin); Texas screech owl: *Ornithomyia fringillina* (ae); *Lynchia americana* (br).
Otus asio macfarlanei (Brewster); MacFarlane's screech owl: *Lynchia americana* (br).
Otus asio naevius (Gmelin); eastern screech owl; hibou maculé or petit-duc: *Ornithoica vicina* (br); *Lynchia americana* (br).
Otus asio quercinus Grinnell; Pasadena screech owl: *Lynchia americana* (br).
Otus choliba choliba (Vieillot): *Lynchia americana* (br).
Otus guatemalae guatemalae (Sharpe): *Ornithoica vicina* (br); *Lynchia wolcotti* (br).
Otus nudipes nudipes (Daudin): *Ornithoctona erythrocephala* (?ae).
Pseudoscops grammicus (Gosse); Jamaican owl: *Ornithoica vicina* (br); *Ornithoctona erythrocephala* (?ae).
Pulsatrix perspicillata pulsatrix (Wied): *Lynchia americana* (br).
Rhinoptynx clamator clamator (Vieillot); mocho-orelhudo in Brazil: *Lynchia americana* (br); *Lynchia albipennis* (ae); *Lynchia wolcotti* (br).
Speotyto cunicularia grallaria (Temminck); caboré-do-campo or coruja-buraqueira in Brazil: *Lynchia americana* (br).
Speotyto cunicularia hypugaea (Bonaparte); western burrowing owl; zacatecólotl in Mexico: *Lynchia americana* (br).
Strix hylophila Temminck: *Ornithoica vicina* (br); *Lynchia americana* (br).
Strix nebulosa nebulosa J.R. Forster; great gray owl; chouette cendrée: *Ornithoctona erythrocephala* (?ae); *Lynchia americana* (br).
Strix occidentalis occidentalis (Xantus); California spotted owl: *Ornithoica vicina* (br).
Strix occidentalis caurina (Merriam); northern spotted owl: *Lynchia americana* (br.)
Strix occidentalis lucida (Nelson); Mexican spotted owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Strix rufipes rufipes King; concón in Chile: *Ornithoica vicina* (br).
Strix varia varia Barton; northern barred owl; chat-huant: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lynchia angustifrons* (ae).
Strix varia georgica Latham [*S. v. alleni* Ridgway]; Florida barred owl: *Lynchia americana* (br); *Olfersia sordida* (ae).
Surnia ulula caparoch (P.L.S. Müller); American hawk owl; chouette épervière: *Ornithomyia fringillina* (ae).
Tyto alba contempta (Hartert): *Ornithoctona erythrocephala* (?ae); *Olfersia fossulata* (ae).
Tyto alba furcata Temminck: *Ornithoica vicina* (br); *Ornithoctona erythrocephala* (?ae).

Tyto alba pratincola (Bonaparte); barn owl; lechuza or yohoaltecolotl in Mexico: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lynchia albipennis* (ac).
Tyto alba tuidara J. E. Gray; suindara in Brazil: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lynchia wolcotti* (br).

15. **Order Caprimulgiformes**

Caprimulgidae (Goatsuckers)

Caprimulgus carolinensis Gmelin; chuck-will's widow: *Pseudolynchia brunnea* (br); *Microlynchia pusilla* (ac).
Caprimulgus vociferus vociferus (Wilson); whip-poor-will; puevy or eheca-chichinqui (Náhuatl) in Mexico: *Pseudolynchia brunnea* (br).
Chordeiles acutipennis acutipennis (Hermann): *Pseudolynchia brunnea* (br).
Chordeiles minor minor (Forster); eastern nighthawk; mange-maringouins: *Pseudolynchia brunnea* (br).
Chordeiles minor chapmani Coues; Florida nighthawk: *Pseudolynchia brunnea* (br).
Chordeiles minor gundlachii Lawrence: *Ornithoctona erythrocephala* (ac).
Hydropsalis brasiliana brasiliana (Gmelin) [*H. torquata* Gmelin]: *Pseudolynchia brunnea* (br).
Nyctidromus albicollis derbyanus Gould; curiango in Brazil: *Pseudolynchia brunnea* (br).
Phalaenoptilus nuttallii nuttallii (Audubon); Nuttall's poor-will; paxacua in Mexico: *Pseudolynchia brunnea* (br).
Setopagis parvula parvula (Shaw and Nodder); dormilon in Argentina: *Pseudolynchia brunnea* (br).
Siphonorhis americanus americanus (Linnaeus): *Ornithoctona erythrocephala* (ac; in Jamaica, where the bird is now extinct).

16. **Order Apodiformes**

Apodidae (Swifts)

Aëronautes montivagus montivagus (d'Orbigny and Lafresnaye): *Myiophthiria* (*Brachypteromyia*) *neotropica* (br).
Aëronautes saxatilis saxatilis (Woodhouse); white-throated swift: *Myiophthiria* (*Brachypteromyia*) *fimbriata* (br).
Nephoecetes [now *Cypseloides*] *niger borealis* (Kennerly); black swift: *Myiophthiria* (*Brachypteromyia*) *fimbriata* (br).

Trochilidae (Hummingbirds)

Phaethornis superciliosus longirostris (De Lattre): *Ornithoctona* (*Ornithopertha*) *nitens* (?ac).

17. **Order Trogoniformes**

Trogonidae (Trogons)

Pharomachrus mocino mocino de la Llave: *Ornithoctona erythrocephala* (ac); *Ornithoctona* (*Ornithopertha*) *nitens* (br).
Pharomachrus mocino costaricensis Cabanis: *Ornithoctona fusciventris* (ac); *Ornithoctona* (*Ornithopertha*) *nitens* (br).
Temnotrogon roseigaster (Vieillot): *Ornithoctona erythrocephala* (ac).
Trogon sp.?: *Ornithoctona* (*Ornithopertha*) *nitens* (br); *Lynchia angustifrons* (ac).
Trogon collaris puella Gould: *Ornithoctona* (*Ornithopertha*) *nitens* (br).
Trogon massena massena Gould: *Ornithoctona* (*Ornithopertha*) *nitens* (br).
Trogon personatus personatus Gould: *Ornithoctona* (*Ornithopertha*) *nitens* (br).

Trogon surrucura aurantius Spix; surucua in Brazil: *Stilbometopa ramphastonis* (ac).

18. Order Coraciiformes

Alcedinidae (Kingfishers)

Megaceryle alcyon alcyon (Linnaeus); eastern belted kingfisher; martin-pêcheur: *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (ac).

Momotidae (Motmots)

Baryphthengus ruficapillus ruficapillus (Vieillot) [*Momotus "rufescens"* of some authors]; juruva, formigão, or pururú in Brazil: *Lynchia angustifrons* (ac).
Momotus momota momota (Linnaeus): *Ornithoctona fusciventris* (ac).
Momotus momota aequatorialis Gould: *Ornithoctona erythrocephala* (ac).
Momotus momota chlorolaemus Berlepsch and Stolzmann: *Ornithoctona erythrocephala* (ac).
Momotus momota coeruliceps (Gould): *Lynchia angustifrons* (ac).
Momotus momota lessonii Lesson: *Ornithoctona fusciventris* (ac).
Momotus momota subrufescens Sclater: *Ornithoctona fusciventris* (ac).

19. Order Piciformes

Picidae (Woodpeckers)

Colaptes auratus luteus Bangs; northern flicker; pivert doré: *Ornithomyia fringillina* (ac).
Colaptes cafer cafer (Gmelin); northwestern flicker: *Ornithomyia fringillina* (ac).
Colaptes cafer collaris Vigors; red-shafted flicker: *Ornithomyia fringillina* (ac).
Colaptes campestris campestroides (Malherbe) [*Geopicos agricola* Malherbe]; pícapau in Brazil: *Ornithoica vicina* (ac).
Colaptes pitius pitius (Molina): *Ornithomyia parva* (= *remota*) (ac).
Dendrocopos [formerly *Dryobates*] *pubescens pubescens* (Linnaeus); southern downy woodpecker: *Ornithoica vicina* (ac).
Dendrocopos pubescens gairdnerii (Audubon); Gairdner's downy woodpecker: *Ornithomyia fringillina* (ac).
Dendrocopos pubescens leucurus (Hartlaub); Batchelder's woodpecker: *Ornithomyia fringillina* (ac).
Dendrocopos pubescens medianus (Swainson); northern downy woodpecker; pic minule: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (ac).
Dendrocopos villosus villosus (Linnaeus); eastern hairy woodpecker; pic chevelu: *Ornithomyia fringillina* (ac).
Dendrocopos villosus extimus (Bangs): *Ornithoctona fusciventris* (ac).
Dendrocopos villosus harrisi (Audubon); Harris' woodpecker: *Ornithomyia fringillina* (ac).
Dryocopus [formerly *Ceophloeus* or *Hylatomus*] *pileatus abieticola* (Bangs); northern pileated woodpecker: *Lynchia americana* (ac).
Melanerpes herminieri Lesson [*Linneopicus therminieri* of some authors]: *Ornithoctona erythrocephala* (ac).
Melanerpes superciliaris superciliaris (Temminck): *Ornithoctona erythrocephala* (ac).
Picoides arcticus (Swainson); arctic three-toed woodpecker; pic à dos noir: *Ornithomyia fringillina* (ac).
Sphyrapicus varius varius (Linnaeus); yellow-bellied sapsucker; pic à ventre jaune: *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (ac).

Sphyrapicus varius nuchalis Baird; red-naped sapsucker: *Ornithomyia fringillina* (ac).
Sphyrapicus varius ruber (Gmelin); northern red-breasted sapsucker: *Ornithomyia fringillina* (ac).
Veniliornis affinis ruficeps (Spix): *Lynchia angustifrons* (ac).

Ramphastidae (Toucans)

Pteroglossus aracari aracari (Linnaeus) [*P. a. wiedi* Sturm]; araçarí in Brazil: *Lynchia angustifrons* (ac).
Ramphastos dicolorus Linnaeus; tucano-de-bico-verde in Brazil: *Ornithoica vicina* (ac); *Ornithoctona erythrocephala* (ac); *Lynchia angustifrons* (ac).
Ramphastos sulfuratus sulfuratus Lesson: *Ornithoica vicina* (ac); *Lynchia angustifrons* (ac).
Ramphastos sulfuratus brevicarinatus Gould: *Lynchia angustifrons* (ac).
Ramphastos swainsonii Gould: *Ornithoica vicina* (ac); *Stilbometopa ramphastonis* (?br); *Lynchia angustifrons* (ac).
Ramphastos toco toco P.L.S. Müller; tucanuçú in Brazil: *Ornithoica vicina* (ac).
Ramphastos vitellinus ariel Vigors; tucano-de-bico-preto in Brazil: *Ornithoica vicina* (ac).

20. **Order Passeriformes**

Rhinocryptidae (Tapaculos)

Scytalopus femoralis sanctae-martae Chapman: *Ornithoctona fusciventris* (?br).

Formicariidae (Antbirds)

Cercomacra tyrannina rufiventris (Lawrence): *Ornithoctona fusciventris* (br).
Chamaeza campanisona campanisona (Lichtenstein) [*Turdus brevicaudus* Vieillot]: *Stilbometopa podopostyla* (ac); *Lynchia plaumanni* (?br).
Drymophila ferruginea (Temminck): *Ornithoica vicina* (?br).
Grallaria rufula rufula Lafresnaye: *Ornithoctona fusciventris* (br).
Thamnophilus caerulescens caerulescens Vieillot; choca in Brazil: *Ornithoctona fusciventris* (br).
Thamnophilus caerulescens gilvigaster Pelzeln: *Ornithoctona fusciventris* (br).
Thamnophilus melanchrous Sclater and Salvin: *Ornithoctona fusciventris* (br).
Thamnophilus unicolor grandior Hellmayr: *Lynchia holoptera* (?br).

Furnariidae (Ovenbirds, Woodhewers); including Dendrocolaptidae

Anabacerthia striaticollis striaticollis Lafresnaye: *Ornithoctona fusciventris* (br).
Asthenes patagonica (d'Orbigny): type host of *Ornithomyia synallaxidis* Lynch-Arribalzaga, 1881 (? = *Ornithomyia parva* Macquart, 1843).
Cinclodes nigro-fumosus (d'Orbigny and Lafresnaye): *Ornithomyia parva* (br).
Lepidocolaptes affinis lachrymiger (Des Murs): *Ornithoctona fusciventris* (br).
Margarornis squamiger squamiger (d'Orbigny and Lafresnaye): *Ornithoctona erythrocephala* (ac).
Sclerurus scansor scansor (Ménétriés); vira-fôhls or pinchacisco in Brazil: *Ornithoctona fusciventris* (br).
Synallaxis unirufa unirufa Lafresnaye: *Ornithoctona fusciventris* (br).
Syndactyla rufosuperciliata rufosuperciliata (Lafresnaye): *Ornithoica vicina* (br).
Thripadectes flammulatus flammulatus (Eyton): *Ornithoica vicina* (br).
Xenops rutilans rutilans Temminck: *Ornithomyia* (*Pseudornithomyia*) *ambigua* (ac).

Tyrannidae (Tyrant Flycatchers)

Agriornis livida livida (Kittlitz); diucon in Chile: *Ornithomyia parva* (br).
Cnemotriccus poecilurus poecilurus (Sclater): *Ornithoctona oxycera* (?br).
Colonia colonus colonus (Vieillot): *Ornithoctona fusciventris* (br).
Empidonax flavescens Lawrence: *Ornithoctona fusciventris* (br).
Empidonax flaviventris (Baird): *Ornithoctona fusciventris* (br).
Empidonax virescens (Vieillot); American flycatcher: *Ornithoctona fusciventris* (br).
Muscisaxicola fluviatilis Sclater and Salvin: *Ornithoctona fusciventris* (br).
Muscisaxicola macloviana mentalis d'Orbigny and Lafresnaye: *Ornithomyia parva* (br).
Muscivora tyrannus (Linnaeus); fork-tailed flycatcher: *Stilbometopa ramphastonis* (?ae).
Myiobius barbatus atricaudus (Lawrence): *Ornithoctona erythrocephala* (?ae).
Myiochanes fumigatus ardosiacus (Lafresnaye): *Ornithoctona fusciventris* (br).
Myiodynastes chrysocephalus chrysocephalus (Tschudi): *Ornithoctona oxycera* (?br).
Myiodynastes hemichrysus (Cabanis): *Ornithoica vicina* (br).
Myiotheretes striaticollis striaticollis (Sclater): *Ornithoctona fusciventris* (br).
Pitangus sulphuratus maximiliani (Cabanis and Heyne); bemtevi-commum in Brazil: *Ornithoica vicina* (br).
Pyrocephalus rubinus obscurus Gould: *Ornithoica vicina* (br).
Sayornis saya saya (Bonaparte); Say's phoebe: *Ornithomyia fringillina* (?br).
Tyrannus melancholicus melancholicus Vieillot: *Ornithoica vicina* (br).
Tyrannus tyrannus (Linnaeus); eastern kingbird; tritri: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br).

Pipridae (Manakins)

Pipra chloromeros (Tschudi): *Ornithoctona erythrocephala* (ae).

Cotingidae (Cotingas)

Cephalopterus ornatus ornatus Geoffroy de St. Hilaire: *Ornithoica vicina* (br).
Lipaugus holerythrus holerythrus Sclater and Salvin: *Ornithoctona fusciventris* (ae).
Platypsaris niger (Gmelin) [*Tityra leuconotus* of authors]: *Ornithoctona erythrocephala* (ae); *Stilbometopa fulvifrons* (ae).
Pyroderus scutatus scutatus (Shaw); pavó in Brazil: *Ornithoica vicina* (br); *Lynchia angustifrons* (ae).

Hirundinidae (Swallows)

Alopochelidon fuscata (Temminck): *Crataerina seguyi* (br).
Iridoprocne albiventer (Boddaert): *Ornithomyia* (*Pseudornithomyia*) *ambigua* (br).
Notiochelidon [or *Pygochelidon*] *cyanoleuca cyanoleuca* (Vieillot); andorinha-pequena in Brazil: *Ornithomyia* (*Pseudornithomyia*) *ambigua* (br).
Notiochelidon cyanoleuca patagonica (d'Orbigny and Lafresnaye): *Crataerina seguyi* (br).
Notiochelidon murina (Cassin): *Crataerina seguyi* (br).
Progne chalybea domestica (Vieillot); andorinha-grande in Brazil: *Ornithomyia* (*Pseudornithomyia*) *ambigua* (br).
Stelgidopteryx ruficollis ruficollis (Vieillot): *Ornithomyia* (*Pseudornithomyia*) *ambigua* (br).
Tachycineta thalassina lepida Mearns; violet-green swallow: *Myiophthiria* (*Brachypteromyia*) *fimbriata* (br).

Muscicapidae (Flycatchers, Warblers, Thrushes, etc.); including Sylviidae,

Turdidae, Compsothlypidae or Parulidae, Mimidae, Troglodytidae, Chamaeidae, and Cinclidae.

Catharus occidentalis occidentalis (Sclater): *Ornithomyia fringillina* (?ac).
Chamaea fasciata phaea Osgood; coast wren-tit: *Ornithoica vicina* (?br).
Cinclus mexicanus unicolor Bonaparte; dipper: *Ornithoica vicina* (br).
Cinnycerthia unirufa unirufa (Lafresnaye): *Ornithoctona fusciventris* (br).
Compsothlypis [now *Parula*] *americana pusilla* (Wilson); northern parula warbler; fauvette parula: *Ornithomyia fringillina* (?br).
Corthylio [now in *Regulus*] *calendula calendula* (Linnaeus); eastern ruby-crowned kinglet; roitelet à couronne rubis: *Ornithoica vicina* (br).
Corthylio [now in *Regulus*] *calendula cineraceus* (Grinnell); western ruby-crowned kinglet: *Ornithoica vicina* (br).
Dendroica aestiva aestiva (Gmelin) [*Dendroica petechia aestiva*]; eastern yellow warbler; fauvette jaune: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Dendroica castanea (Wilson); bay-breasted warbler; fauvette à poitrine baie: *Ornithomyia fringillina* (br).
Dendroica coronata coronata (Linnaeus); myrtle warbler; fauvette à croupion jaune: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Dendroica graciae decora Ridgway: *Ornithoctona fusciventris* (br).
Dendroica pinus pinus (Wilson); northern pine warbler: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Dendroica pinus chrysoleuca Griscom: *Ornithoctona fusciventris* (br).
Dendroica striata (J.R. Forster); black-poll warbler; fauvette rayée: *Ornithoctona oxycera* (?ac).
Dendroica tigrina (Gmelin); Cape May warbler: *Ornithomyia fringillina* (br); *Ornithoctona fusciventris* (br).
Dumetella carolinensis (Linnaeus); catbird; merle-chat: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Geothlypis trichas trichas (Linnaeus); Maryland yellow-throat; fauvette masquée: *Ornithomyia fringillina* (br).
Geothlypis trichas brachidactyla (Swainson); northern yellow-throat: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Helmitheros vermivorus (Gmelin); worm-eating warbler: *Ornithomyia fringillina* (br).
Henicorhina leucophrys collina (Bangs): *Ornithoctona fusciventris* (br).
Hylocichla fuscescens fuscescens (Stephens); veery; grive de Wilson: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Hylocichla fuscescens salicicola Ridgway; willow thrush: *Pseudolynchia brunnea* (ac).
Hylocichla guttata guttata (Pallas); Alaska hermit thrush: *Ornithomyia fringillina* (br).
Hylocichla guttata faxoni Bangs and Penard; eastern hermit thrush: grive solitaire: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Hylocichla mustelina (Gmelin); wood thrush: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Stilbometopa fulvifrons* (ac); *Lynchia angustifrons* (ac).
Hylocichla ustulata ustulata (Nuttall); russet-backed thrush; grive à dos olive: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Hylocichla ustulata swainsoni (Tschudi); olive-backed thrush: *Ornithomyia fringillina* (br).
Icteria virens longicauda Lawrence [*Icteria virens auricollis* (Lichtenstein)]; long-tailed chat: *Ornithomyia fringillina* (br).
Mimus polyglottos polyglottos (Linnaeus); eastern mockingbird: *Microlynchia pusilla* (?br).
Mimus polyglottos leucopterus (Vigors); western mockingbird: *Ornithoica vicina* (br); *Microlynchia pusilla* (?br).
Mimus thenca (Molina); thenca in Chile: *Ornithomyia parva* (br).

Mniotilta varia (Linnaeus); black-and-white warbler; fauvette noire-et-blanche: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br); *Ornithoctona fusciventris* (br).

Myadestes townsendi townsendi (Audubon); Townsend's solitaire: *Ornithomyia fringillina* (?br).

Nesocichla eremita Gould [including *N. eremita gordoni* Starchies]; Tristan da Cunha hermit thrush: *Ornithomyia parva* (br).

Oporornis formosus (Wilson); Kentucky warbler: *Ornithomyia fringillina* (br).

Platycichla flavipes leucops (Taczanowski): *Ornithoctona fusciventris* (br).

Regulus satrapa satrapa Lichtenstein; eastern golden-crowned kinglet; roitelet à couronne dorée: *Ornithoica vicina* (br).

Regulus satrapa olivaceus Baird; western golden-crowned kinglet: *Ornithoica vicina* (br).

Seiurus aurocapillus aurocapillus (Linnaeus); oven-bird; fauvette à fourneau: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Ornithoctona fusciventris* (br).

Seiurus noveboracensis noveboracensis (Gmelin); northern water-thrush; fauvette des ruisseaux du nord: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Setophaga ruticilla ruticilla (Linnaeus); American redstart; fauvette flamboyante: *Ornithomyia fringillina* (?br); *Ornithoctona fusciventris* (br).

Sialia sialis sialis (Linnaeus); eastern bluebird; oiseau-bleu: *Ornithomyia fringillina* (br).

Thryomanes bewickii spilurus (Vigors); Vigors' wren: *Ornithomyia fringillina* (?br).

Thryothorus ludovicianus ludovicianus (Latham); Carolina wren: *Ornithomyia fringillina* (?br).

Toxostoma curvirostre curvirostre (Swainson) [*Toxostoma curvirostre celsum* Moore]; curve-billed thrasher: *Microlynchia pusilla* (?br).

Toxostoma dorsale dorsale Henry [*T. crissalis* Henry]; crissal thrasher: *Microlynchia pusilla* (?br).

Toxostoma redivivum redivivum (Gambel); California thrasher: *Lynchia hirsuta* (ae).

Toxostoma rufum rufum (Linnaeus); eastern brown thrasher; grive rousse: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Microlynchia pusilla* (?br).

Troglodytes aëdon aëdon Vieillot; eastern house wren; railleur or troglodyte domestique: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Troglodytes aëdon parkmanii Audubon; western house wren: *Ornithoica vicina* (br).

Troglodytes musculus musculus Naumann [*Troglodytes wiedi* Berlepsch]; cambaxirra in Brazil: *Ornithoica vicina* (br).

Troglodytes musculus inquietus (Baird): *Ornithoctona* (*Ornithopertha*) *nitens* (ae).

Turdus fuscater gigas Fraser: *Ornithoctona fusciventris* (br).

Turdus grayi casius (Bonaparte): *Ornithoica vicina* (br).

Turdus magellanicus King; zorzal in Chile: *Ornithoica vicina* (br); *Ornithomyia parva* (br).

Turdus migratorius migratorius Linnaeus; eastern or American robin; merle d'Amérique: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Turdus migratorius propinquus Ridgway; western robin: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Turdus olivater sanctae-martae (Todd): *Ornithoctona oxycera* (?br); *Ornithoctona* (*Ornithopertha*) *nitens* (?br).

Turdus plebeius Cabanis: *Ornithoctona fusciventris* (br).

Turdus tristis cnephosa (Bangs): *Ornithoctona fusciventris* (br).

Vermivora celata lutescens (Ridgway); lutescent warbler: *Ornithomyia fringillina* (br).
Vermivora peregrina (Wilson); Tennessee warbler: *Ornithomyia fringillina* (br).
Vermivora pinus (Linnaeus); blue-winged warbler: *Ornithomyia fringillina* (br).
Vermivora ruficapilla ruficapilla (Wilson); Nashville warbler; fauvette à joues grises: *Ornithomyia fringillina* (br).
Wilsonia canadensis (Linnaeus); Canada warbler; mésange du Canada: *Ornithoctona fusciventris* (br).
Wilsonia citrina (Boddaert); hooded warbler: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br).

Motacillidae (Wagtails, Pipits)

Anthus spinoletta rubescens (Tunstall); American pipit: *Ornithomyia fringillina* (?ae).

Laniidae (Shrikes)

Lanius ludovicianus excubitorides Swainson; white-rumped shrike: *Ornithomyia fringillina* (?br).
Lanius ludovicianus migrans Palmer; loggerhead shrike: *Ornithoica vicina* (?br); *Ornithomyia fringillina* (?br).

Sittidae (Nuthatches)

Sitta carolinensis carolinensis Latham [*Sitta carolinensis cookei* Oberholser]; white-breasted nuthatch: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Sitta pygmaea pygmaea Vigors; pygmy nuthatch: *Lipoptena depressa* (ae).

Paridae (Titmice)

Baeolophus [now in *Parus*] *bicolor* (Linnaeus); tufted titmouse: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Baeolophus [now in *Parus*] *inornatus inornatus* (Gambel); plain titmouse: *Ornithomyia fringillina* (br).
Penthestes [now in *Parus*] *atricapillus atricapillus* (Linnaeus); black-capped chickadee; mésange à tête noire: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Penthestes [now in *Parus*] *hudsonicus hudsonicus* (J.R. Forster); Hudsonian chickadee; mésange à tête brune: *Ornithomyia fringillina* (br).
Penthestes [now in *Parus*] *rufescens barlowi* (Grinnell); Barlow's chickadee: *Ornithomyia fringillina* (br).

Vireonidae (Vireos)

Vireo philadelphicus (Cassin); Philadelphia vireo: *Ornithoctona fusciventris* (?br)

Thraupidae (Tanagers, Honeycreepers); including Coerebidae

Calospiza arthus aurulenta (Lafresnaye): *Ornithoctona fusciventris* (br).
Calospiza labradorides labradorides (Boissonneau): *Ornithoctona fusciventris* (br).
Conirostrum rufum Lafresnaye: *Ornithoctona fusciventris* (br).
Dubusia taeniata taeniata (Boissonneau): *Ornithoctona fusciventris* (br).
Piranga bidentata sanguinolenta (Lafresnaye): *Ornithoctona fusciventris* (br).
Piranga erythromelas Vieillot [*Piranga olivacea* (Gmelin)]; scarlet tanager; tanagra écarlate: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br); *Ornithoctona fusciventris* (br).

Piranga flava hepatica (Swainson); hepatic tanager: *Ornithoica vicina* (br); *Ornithoctona fusciventris* (br).
Piranga leucoptera leucoptera (Trudeau): *Ornithoctona fusciventris* (br).
Piranga ludoviciana (Wilson); western tanager: *Ornithomyia fringillina* (br).
Piranga rubra rubra (Linnaeus); summer tanager: *Ornithoctona fusciventris* (br); *Lynchia albipennis* (ac).
Poecilothraupis igniventris lunulata (Du Bus): *Ornithoctona fusciventris* (br).
Poecilothraupis lachrymosa lachrymosa (Du Bus): *Ornithoctona fusciventris* (br).
Ramphocelus bresilius dorsalis Sclater: *Ornithoica vicina* (br).
Tachyphonus rufus (Boddaert): *Ornithoctona fusciventris* (br).
Tachyphonus xanthopygius xanthopygius Sclater: *Ornithoctona fusciventris* (br).
Thlypopsis sordida chrysopis (Sclater and Salvin): *Ornithoctona fusciventris* (br).
Thraupis cyanocephala olivicyanea (Lafresnaye): *Ornithoctona oxycera* (?br).

Fringillidae (Finches)

Ammodramus savannarum australis Maynard [*Ammodramus savannarum pratensis* (Vieillot)]; eastern grasshopper sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Arremonops rufivirgatus (Lawrence): Texas sparrow: *Microlynchia pusilla* (?ac).
Arremonops striaticeps (Lafresnaye): *Microlynchia pusilla* (?ac).
Atlapetes gutturalis (Lafresnaye): *Ornithoctona fusciventris* (br).
Atlapetes schistaceus schistaceus (Boissonneau): *Ornithoctona fusciventris* (br).
Atlapetes schistaceus tamae Cory: *Ornithoctona fusciventris* (br).
Atlapetes torquatus nigrifrons (Chapman): *Ornithoctona fusciventris* (br).
Carpodacus mexicanus frontalis (Say); common house finch or California linnet: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Carpodacus purpureus purpureus (Gmelin); eastern purple finch; pinson pourpre commun: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Carpodacus purpureus californicus Baird; California purple finch: *Ornithomyia fringillina* (br).
Coryphospingus cucullatus fargoi Brodkorb: *Ornithoctona fusciventris* (br).
Diuca diuca diuca (Molina) [*Diuca grisea* Sclater]; diuca in Chile: *Ornithomyia parva* (br).
Embernagra platensis olivascens (d'Orbigny); *Ornithomyia parva* (br).
Euetheia olivacea pusilla (Swainson): *Ornithoctona fusciventris* (br).
Hedymeles [now *Pheucticus*] *ludovicianus* (Linnaeus); rose-breasted grosbeak; gros-bec à poitrine rose: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Ornithoctona fusciventris* (br).
Hedymeles melanocephalus melanocephalus (Swainson) [now *Pheucticus melanocephalus maculatus* (Audubon)]; black-headed grosbeak: *Ornithomyia fringillina* (br); *Microlynchia pusilla* (?ac).
Hesperiphona vespertina vespertina (W. Cooper); eastern evening grosbeak: *Ornithomyia fringillina* (br).
Hesperiphona vespertina brooksi Grinnell; western evening grosbeak: *Ornithomyia fringillina* (br).
Junco hyemalis hyemalis (Linnaeus); slate-colored junco; junco ardoisé: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Junco hyemalis carolinensis Brewster; Carolina junco: *Ornithoica vicina* (br).
Junco mearnsi Ridgway [*Junco oreganus mearnsi*]; pink-sided junco: *Ornithomyia fringillina* (br).
Junco oreganus oreganus (Townsend); Oregon junco: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Junco oreganus shufeldti Coale; Shufeldt's junco: *Ornithomyia fringillina* (br).
Junco oreganus thurberi Anthony; Thurber's junco: *Ornithoica vicina* (br); *Lynchia hirsuta* (ac).
Junco phaeonotus dorsalis Henry [*Junco caniceps dorsalis*]; red-backed junco: *Ornithoica vicina* (br).
Junco phaeonotus fulvescens Nelson: *Ornithoctona fusciventris* (br).
Loxia curvirostra bendirei Ridgway; Bendire's crossbill: *Ornithomyia fringillina* (br).
Loxia curvirostra pusilla Gloger [*Loxia curvirostra minor* (Brehm)]; red crossbill; bec-croisé rouge: *Ornithomyia fringillina* (br).
Melospiza georgiana georgiana Latham; swamp sparrow; pinson des marais: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Melospiza lincolnii lincolnii (Audubon); Lincoln's sparrow; pinson de Lincoln: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Melospiza lincolnii gracilis (Kittlitz); Forbush's sparrow: *Ornithomyia fringillina* (br).
Melospiza melodia melodia (Wilson); eastern song sparrow; pinson chanteur: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Melospiza melodia cooperi Ridgway; San Diego song sparrow: *Ornithoica vicina* (br).
Melospiza melodia gouldii Baird; Marin song sparrow: *Ornithoica vicina* (br.)
Melospiza melodia morphna Oberholser; rusty song sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Nesospiza acunhae (Cabanis); Tristan da Cunha bunting: *Ornithomyia parva* (br).
Nesospiza jessiae Eagle Clark; Gough bunting: *Ornithomyia parva* (br).
Nesospiza wilkinsi Lowe; Nightingale Island bunting: *Ornithomyia parva* (br).
Passerculus sandwichensis savanna (Wilson); eastern savannah sparrow; pinson des savanes: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Passerella iliaca subsp.; California fox sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br).
Passerina cyanea (Linnaeus); indigo bunting. *Ornithomyia fringillina* (?br).
Pipilo aberti aberti Baird; Abert's towhee: *Lynchia hirsuta* (ac); *Microlynchia pusilla* (ac).
Pipilo aberti dumeticolus van Rossem; western Abert's towhee: *Lynchia hirsuta* (ac); *Microlynchia pusilla* (ac).
Pipilo erythrophthalmus erythrophthalmus (Linnaeus); red-eyed towhee or chewink: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Pipilo erythrophthalmus alleni Coues; white-eyed towhee: *Ornithoica vicina* (br).
Pipilo erythrophthalmus canaster Howell; Alabama towhee: *Ornithoica vicina* (br).
Pipilo fuscus carolae McGregor; Sacramento brown Towhee: *Ornithoica vicina* (br); *Lynchia hirsuta* (ac).
Pipilo fuscus crissalis (Vigors); California towhee: *Ornithoica vicina* (br); *Lynchia hirsuta* (ac).
Pipilo fuscus mesoleucus Baird; cañon towhee: *Ornithoica vicina* (br); *Microlynchia pusilla* (ac).
Pipilo fuscus petulans Grinnell and Swarth [*Pipilo fuscus wrangeli* (Bonaparte)]; San Francisco brown towhee: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Pipilo fuscus senicula Anthony; Anthony's towhee: *Ornithoica vicina* (br).
Pipilo maculatus falcifer McGregor; San Francisco towhee: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Pipilo maculatus megalonyx Baird; San Diego towhee: *Ornithoica vicina* (br).
Pipilo maculatus montanus Swarth; spurred towhee: *Ornithoica vicina* (br).

Pitylus fuliginosus (Daudin); bico-pimenta in Brazil: *Lynchia angustifrons* (ae).
Plectrophenax nivalis nivalis (Linnaeus); eastern snow bunting; bruant des neiges or oiseau blanc: *Ornithomyia fringillina* (?br).
Pooecetes gramineus gramineus (Gmelin); eastern vesper sparrow; pinson à ailes baies: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Ornithoctona fusciventris* (br).
Poospiza torquata torquata (Lefresnaye and d'Orbigny): *Ornithoctona fusciventris* (br).
Pselliophorus tibialis (Lawrence): *Ornithoctona fusciventris* (br).
Richmondena cardinalis cardinalis (Linnaeus); eastern cardinal: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Microlynchia pusilla* (ae).
Spizella arborea arborea (Wilson); eastern tree sparrow; pinson hudsonien: *Ornithomyia fringillina* (br).
Spizella passerina passerina (Bechstein); eastern chipping sparrow; pinson familier: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Spizella pusilla pusilla (Wilson); eastern field sparrow; pinson des champs: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Zonotrichia albicollis (Gmelin); white-throated sparrow; pinson à gorge blanche: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Lynchia americana* (ae).
Zonotrichia capensis antillarum (Riley): *Ornithoctona fusciventris* (br).
Zonotrichia capensis costaricensis Allen: *Ornithoctona fusciventris* (br).
Zonotrichia capensis peruviensis (Lesson): *Ornithoctona fusciventris* (br).
Zonotrichia coronata (Pallas) [*Zonotrichia atricapilla* (Gmelin)]; golden-crowned sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Zonotrichia leucophrys gambelii (Nuttall); Gambel's sparrow: *Ornithomyia fringillina* (br).
Zonotrichia leucophrys nuttalli Ridgway; Nuttall's sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Zonotrichia leucophrys pugetensis Grinnell; Puget Sound sparrow: *Ornithomyia fringillina* (br).
Zonotrichia pileata Boddaert: *Ornithomyia parva* (=*remota*) (br).

Icteridae (Troupials, American Blackbirds)

Agelaius phoeniceus phoeniceus (Linnaeus); eastern red-wing; étourneau à épaulettes: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Agelaius thilius thilius (Molina); trile in Chile: *Ornithomyia parva* (br).
Dives dives warszewiczi (Cabanis): *Ornithoctona erythrocephala* (ae).
Dolichonyx oryzivorus (Linnaeus); reedbird or bobolink: *Ornithomyia fringillina* (br).
Euphagus carolinus (P.L.S. Müller); rusty blackbird; mainate rouillé: *Ornithomyia fringillina* (br).
Euphagus cyanocephalus (Wagler); Brewster's blackbird: *Ornithoica vicina* (br).
Holoquiscalis jamaicensis gundlachii (Cassin): *Ornithoctona erythrocephala* (ae); *Stilbometopa fulvifrons* (?ae).
Icterus galbula Linnaeus; Baltimore oriole; oriole de Baltimore: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Icterus mesomelas mesomelas (Wagler): *Ornithoctona fusciventris* (br).
Molothrus ater ater (Boddaert); eastern cowbird; vacher: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Molothrus ater artemisiae Grinnell; Nevada cowbird: *Ornithomyia fringillina* (br).
Molothrus ater obscurus (Gmelin); dwarf cowbird: *Ornithoica vicina* (br); *Microlynchia pusilla* (ae).

Quiscalus quiscula quiscula (Linnaeus) [*Quiscalus quiscula stonei* Chapman]; purple grackle; grand mainate: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Quiscalus quiscula aeneus Ridgway [*Quiscalus quiscula versicolor* Vieillot]; bronzed grackle: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Sturnella magna magna (Linnaeus); eastern meadow lark; étourneau des prés: *Microlynchia pusilla* (?ac).

Sturnella magna meridionalis Sclater: *Ornithoctona fusciventris* (?br).

Sturnella militaris (Linnaeus): *Ornithomyia parva* (?br).

Xanthornus decumanus maculosus (Chapman): *Ornithoctona erythrocephala* (ac).

Ploceidae (Weaverbirds)

**Passer domesticus domesticus* (Linnaeus); English sparrow, moineau domestique: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (ac).

Sturnidae (Starlings)

**Acridotheres* [formerly *Aethiopsar*] *cristatellus cristatellus* (Linnaeus); Chinese or Japanese starling, or crested mynah: *Ornithomyia fringillina* (ac).

**Sturnus vulgaris vulgaris* Linnaeus; starling; étourneau: *Ornithomyia fringillina* (ac).

Corvidae (Crows, Jays)

Aphelocoma californica californica (Vigors) [*Aphelocoma coerulescens californica*]; California jay: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Aphelocoma californica woodhouseii (Baird) [*Aphelocoma coerulescens woodhouseii*]; Woodhouse's jay: *Ornithoica vicina* (br).

[*Calocitta formosa formosa* (Swainson): *Lynchia americana* (ac, in Zoological Park)].

Corvus brachyrhynchos brachyrhynchos Brehm [*C. americanus* Audubon]; eastern crow; corneille d'Amérique: *Ornithoica vicina* (br); *Lynchia americana* (ac).

Corvus brachyrhynchos hesperis Ridgway; western crow: *Ornithomyia fringillina* (?br).

Corvus jamaicensis (Brisson): *Ornithoctona erythrocephala* (?br).

Corvus ossifragus Wilson; fish crow: *Lynchia americana* (ac).

Cyanocitta cristata cristata (Linnaeus) [*Cyanocitta cristata bromia* Oberholser]; northern blue jay; geai bleu: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Cyanocitta stelleri stelleri (Gmelin); Steller's jay: *Ornithoica vicina* (br).

Cyanocitta stelleri frontalis (Ridgway); blue-fronted jay: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Lynchia hirsuta* (ac).

Cyanocorax caeruleus (Vieillot); gralha-azul in Brazil: *Ornithoica vicina* (br); *Lynchia angustifrons* (ac).

Cyanocorax chrysops chrysops (Vieillot); gralha-do-mato in Brazil: *Ornithoica vicina* (br).

Cyanolyca pulchra mitrata Ridgway: *Ornithoctona erythrocephala* (?ac).

Perisoreus canadensis canadensis (Linnaeus); Canada jay: geai du Canada: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br).

Pica pica hudsonia (Savine); American magpie: *Ornithoica vicina* (?br).

Uroleuca cristatella (Temminck): *Ornithoica vicina* (br).

Xanthoura yncas cyanodorsalis (Dubois): *Ornithoctona fusciventris* (?br).

II. Mammals

The nomenclature and sequence of the orders, families and genera are those of G.L. Simpson (1945). In the absence of an

up-to-date catalogue of all New World mammals, the specific and subspecific names were obtained from a variety of sources. Only a selection of English and other vernacular names is included.

As in the list of birds, "(br)" marks a true breeding host, "(ac)" an accidental or stray host, and an asterisk a host introduced by Man.

1. Order Carnivora

Canidae (Dogs, Wolves, Foxes)

Canis latrans Say; coyote: *Melophagus ovinus* (ac; introduced).
Canis lupus subsp.; Alaskan wolf: *Melophagus ovinus* (ac; introduced).

Mustelidae (Weasels and Allies)

Tayra [or *Grison*, or *Galera*] *barbara* (Linnaeus); grison: *Lipoptena mazamae* (ac).

2. Order Artiodactyla

Tayassuidae (Pecaris)

Tayassu [or *Pecari*] *angulatus* Cope; pecari: *Lipoptena mazamae* (ac).

Cervidae (Deer and Brocket)

Cervus canadensis Erxleben; wapiti or American elk: *Lipoptena cervi* (?ac; introduced); *Lipoptena depressa* (?ac).
Mazama americana (Erxleben); brocket: *Lipoptena mazamae* (br).
Mazama simplicicornis simplicicornis (Illiger); virá, virote, guazú-birá, guazú-caatinga in Brazil; matacan in Venezuela; biracho, sachacabra, or guazuncho in Argentina: *Lipoptena mazamae* (br).
Mazama simplicicornis nemorivaga (Cuvier); guazú-pitha: *Lipoptena mazamae* (br).
Mazama tema tema Rafinesque: *Lipoptena mazamae* (br).
Mazama tema reperticia Goldman: *Lipoptena mazamae* (br).
Odocoileus hemionus hemionus (Rafinesque); mule deer: *Neolipoptena ferrisi* (br); *Lipoptena depressa* (br); *Melophagus ovinus* (ac; introduced).
Odocoileus hemionus columbianus (Richardson); coast deer or black-tailed deer: *Neolipoptena ferrisi* (br); *Lipoptena depressa* (br).
Odocoileus virginianus virginianus Boddaert; Virginia deer: *Lipoptena mazamae* (br).
Odocoileus virginianus borealis Miller; northeastern Virginia deer: *Lipoptena cervi* (br; introduced).
Odocoileus virginianus gymnotis (Wiegmann); Venezuelan white-tailed deer; venado: *Lipoptena mazamae* (br).
Odocoileus virginianus leucurus (Douglas); western white-tailed deer: *Neolipoptena ferrisi* (br); *Lipoptena depressa* (br).
Odocoileus virginianus mexicanus (Gmelin) [*O. v. toltecus* de Saussure; *O. v. acapulcensis* Caton]; Mexican white-tailed deer; venado: *Lipoptena mazamae* (br).
Odocoileus virginianus osceola (Bangs); Florida deer: *Lipoptena mazamae* (br).
Odocoileus virginianus rothschildi (Thomas); Panama white-tailed deer: *Lipoptena mazamae* (br).
Ozotoceros [or *Blastocerus*] *bezoarticus* (J.E. Gray); pampas deer; guazú-ti or veado-campeiro in Brazil: *Lipoptena guimarãesi* (br).

Antilocapridae

Antilocapra americana Ord; prong-horn antelope: *Neolipoptena ferrisi* (ac).

Bovidae (Cattle, Sheep, Goats)

**Ovis aries* Linnaeus; domestic sheep: *Melophagus ovinus* (br; introduced).
Ovis (?*canadensis* Shaw or *dalli* Allen); American mountain sheep: [?*Melophagus ovinus*, introduced; very doubtful record].

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SUPPLEMENTARY BIBLIOGRAPHY OF HIPPOBOSCIDAE

Anonymous 1939 Method of eradicating the sheep tick or fly. *Southwest. Sheep Goat Raiser*, **9**, No. 17, pp. 30–31.

1941*b* Resistance of sheep ked pupae to poisons. *Pastoral Rev. Graziers Rec.*, **51**, No. 11, p. 865.

1942*a* Use "ked" not "sheep tick." *Agric. Gaz. New South Wales*, **53**, No. 2, p. 76.

1942*b* Keds infestation heaviest in young sheep. Low condition in mature animals increases susceptibility. *Farmer's Weekly, Bloemfontein*, **63**, p. 777.

1945*b* Destruction of sheep ticks by dipping in dilute rotenone dips. *U.S. Dept. Agric., Bur. An. Ind., Zool. Div.*, 2 pp.

1951*a* Control of lice and sheep ticks on sheep and goats. *U.S. Dept. Agric., Agric. Res. Admin., Leaflet* **308**, 11 pp.

1951*b* Control cattle lice, cattle grubs, sheep ticks, garden insects with 1½% rotenone dust. *Wisconsin Agric. Coll. Ext., Spec. Circ.*, 4 pp.

1955*a* The Georg Statz Collection of fossil insects. *Ann. Ent. Soc. America*, **48**, p. 219.

Adachi, Marian S. 1954 Parasites of the native owl. *Proc. Hawaiian Ent. Soc.*, **15**, No. 2, p. 290.

Alexander, S.M.D. 1954 The birds of the Blasket Islands. *Bird Study, Oxford*, **1**, No. 4, pp. 148–168. (Hippoboscidae: p. 168).

Alford, S.W. 1940 Sheep pests and parasites. *Ann. Rept. Nebraska State Bd. Agric.*, pp. 511–513.

Armstrong, E.A. 1953 Nidicoles and parasites of the wren. *Irish Naturalists' Jl.*, **11**, pt. 3, pp. 57–64.

Ash, J. 1953 Notes on the puparial stage of some Hippoboscidae. *Ent. Mo. Mag.*, **89**, pp. 206–207.

1955 Some records of birds and mammal parasites. *Ent. Mo. Mag.*, **91**, pp. 64–65.

Auber, J. 1952 Note sur un Diptère pupipare, ses parasites et hyperparasites. *L'Entomologiste, Paris*, **8**, pts. 3–4, pp. 90–91.

Baker, J.R. 1955 Developmental stages of (a) *Haemoproteus* and (b) trypanosomes in *Ornithomyia*. *Trans. R. Soc. Trop. Med. Hyg.*, **49**, p. 11.

Becher, E. 1882 Zur Kenntniss der Kopfbildung der Dipteren. *Wien. Entom. Zeitg.*, **1**, pp. 49–54.

Beklemishev, V. N. 1954 (Parasitism of arthropods on terrestrial mammals. II. Fundamental trends of its development). *Med. Parazitol. i Parazitarnye Bolezni*, **1**, pp. 3–20. (In Russian. Hippoboscidae: pp. 9 and 11).

Benoit, P.L.G. 1955 Contributions à l'étude de la faune du Ruanda-Urundi (Mission P. Basilewsky, 1953). XXXVI. Diptera. Hippoboscidae. *Ann. Mus. Congo, Tervuren, 8vo, Sci. Zool.*, **36**, p. 317.

Bequaert, J. 1953*a* The Hippoboscidae or louse-flies of mammals and birds. Part I. Structure, physiology and natural history. *Entomologica Americana, (N.S.)*, **32**, (for 1952; published February 20, 1953), pp. 1–209; **33**, (for 1953; published May 26, 1953), pp. 211–442.

1953*b* Hippoboscidae and Nycteribiidae (Diptera Brachycera Cyclorrhapha). *Parc National Albert I, Mission G.F. de Witte* (1933–1935), Fasc. **79**, pt. 7, pp. 89–94.

1954 Hippoboscidae *Res. Norwegian Scient. Exped. Tristan da Cunha 1937–1938*, No. **26**, p. 45.

Bezzi, M. 1911 Etudes systématiques sur les Muscides hématophages du genre *Lyperosia*. *Arch. de Parasitologie*, **15**, pp. 110–143.

Biagi F., F. 1953 La leishmaniasis tegumentaria mexicana y algunos datos médico-estadísticos de Escárcega, Campeche. (Mexico), 119 pp.

Billberg, G.J. 1820 Enumeratio Insectorum in museo Billberg. (Stockholm), 138 pp.

Bogendörfer, L. 1949 Ueber die therapeutische Verwendung von Schafläusen bei Ikterus. *Klinische Wochenschr., Berlin*, **27**, pts. 3–4, p. 67.

1950 Therapeutische Anwendung von Schafläusen bei Hepatitis epid. *Mediz. Klinik, Berlin-Munich-Vienna*, **45**, p. 31.

Bosman, S.W. 1949 Skaapluisvlieg rig subtiele skade aan. *Wolboer, Pretoria*, **18**, January No., pp. 6–8.

Bouvier, G.; Burgisser, H.; and Schneider, P.A. 1952 Observations sur les maladies du gibier, des oiseaux et des poissons en 1951. *Schweizer Arch. Tierheilk.*, **94**, pt. 7, pp. 475–479.

Brauer, F. 1863 Monographie der Oestriden. (Vienna), 292 pp., 10 Pls.

1869 Kurze Charakteristik der Dipteren-Larven zur Bekräftigung des neuen von Dr. Schiner entworfenen Dipteren-Systemes. *Verh. Zool.-Bot. Ver. Wien*, **19**, *Abhandl.*, pp. 843–852.

1880 Die Zweiflügler des kaiserlichen Museums zu Wien. I. *Denkschr. Ak. Wiss. Wien, Math.-Naturw. Kl.*, **42**, pp. 105–216, Pl. 6.

Buchner, P. 1953 Endosymbiose der Tiere mit pflanzlichen Mikroorganismen. (Basel), 771 pp., 3 Pls.

***Büttiker, W.** 1943 Die Lausfliegen der einheimischen Vögel. *Die Vögel der Heimat*, **13**, pt. 5.

1946 Die Parasiten und Nestbewohner des Alpenseglers (*Micropus melba L.*) *Die Vögel der Heimat*, **16**, No. 9, pp. 218–231.

1952 Methods of collecting parasites of birds. *The Ostrich*, **23**, No. 2, pp. 92–93.

Bursell, E. 1955 The polypneustic lobes of the tsetse larva (*Glossina*). *Proc. Roy. Soc., London, Ser. B, Biol. Sci.*, **144**, No. 915, pp. 275–286, Pls. 16–19. (*Hippobosca longipennis:* p. 285).

Burton, J.F. 1953 *Ornithomyia fringillina* Curt. on whitethroat. *Entom. Record*, **65**, pp. 59–60.

1954 Diptera notes from Kent, 1953. *Entom. Record*, **66**, p. 87.

Campbell, H.; and Lee, L. 1953*a* Studies on quail malaria in New Mexico and notes on other aspects of quail populations. *New Mexico Dept. Game Fish*, ix + 79 pp.

1953*b* Completion report. New Mexico Project W-41-R. "Distribution and management of avian malaria in New Mexico quail." (No place; mimeographed), 4 pp.

Carroll, J. 1953 Insect and allied parasites of farm stock. 1. Lice, sheep ked and sheep maggot flies. *Agric. Ireland*, **10**, pp. 271 and 273.

Chagnon, G. 1952 Études préliminaires sur les Diptères du Québec. *Contrib. Inst. Biol. Université Montréal*, No. 32, pp. 1–36.

Chilson, L.M. 1953 Insect records from Johnston Island. *Proc. Hawaiian Ent. Soc.*, **15**, pt. 1, pp. 81–84.

Clasohm, L.A. 1943 Sheep dipping. *Jl. Dept. Agric. South Australia*, **46**, pp. 327–328.

Cloudsley-Thompson, J.L. 1955 Parasitic flies. *Science Progress, London*, **43**, No. 172, pp. 616–628.

Cohen, E. 1955 "Parasitic flies." *Bird Study, Oxford*, **2**, No. 2, p. 97.

Coquillett, D.W. 1901*b* A systematic arrangement of the families of Diptera. *Proc. U.S. Nat. Mus.*, **23**, pp. 653–658.

Corbet, G.B. 1953 A flat-fly marking experiment. *Fair Isle Bird Obs. Bull.*, **1**, No. 12, pp. 45–48.

1955*a* Research on flat-flies at Fair Isle in 1954. *Fair Isle Bird Obs. Bull.*, **2**, No. 7, pp. 313–317.

1955*b* Record of flat-flies from migrants at Fair Isle in 1954. *Fair Isle Bird Obs. Bull.*, **2**, No. 7, pp. 321–322.

Corrêa, O. 1952 Dipteros pupiparos determinados no Rio Grande do Sul.

Sua patogenicidade e contrôle. *Bol. Dir. Prod. Anim., Rio Grande do Sul*, **8**, No. 13, pp. 3–7, 1 Pl.

d'Emden, P.H. 1953 Ked and lice control. *Tasmanian Jl. Agric.*, **24**, No. 2, pp. 137–140.

Detinova, T.S. 1955 (Age changes in the ovaries of the dog hippoboscid, *Hippobosca capensis* Olf.). *Dok. Akad. Nauk USSR*, **103**, p. 937–939. (In Russian).

Dogiel, V.A.; and Karolinskaia, K. 1936 (The parasitic fauna of the swifts (*Apus apus*). The question of the origin of the parasitic fauna of migratory birds). *Uchen. Zapiski Leningrad, Gosudarstv. Univ. Bubnov*, (7), *s. Biol.*, (3), pp. 49–79. (In Russian. *Crataerhina pallida:* pp. 73–74 and 79).

Donoso Barros, R. 1949 Observación de un caso de ectoparasitismo accidental del hombre, por *Olfersia fossulata* Macquart (1843). *Revista Médica Chile*, **77**, No. 6, p. 404.

Downes, J.A. 1952 The hippoboscid fly *Crataerina pallida* in Scotland. *Scottish Naturalist*, **64**, p. 166.

***Downing, W.; Harbour, H.E.; and Stones, L.C.** 1952 Modern insecticides and ectoparasite control. *Veter. Record*, **64**, pp. 787–803.

Dubinin, V.B. 1953 (Feather mites, Analgesoidea. II. Families Epidermoptidae and Freyanidae). *Fauna USSR, Arachnida*, **6**, No. 6, pp. 1–412. (In Russian).

Edwards, A.R.; and Stirling, W.T. 1953 Further records of *Crataerina pallida* (Latr.) in Scotland. *Scottish Naturalist*, **65**, p. 192.

Ennion, E.A.R. 1955 Flat-flies collected at Monkshouse bird observatory, Northumberland. *Fair Isle Bird Obs. Bull.*, **2**, No. 7, p. 320.

Fethers, G. 1954 External parasites of sheep. *Pastoral Rev. Graziers Rec.*, **64**, pp. 1330–1331.

Figueroa Potes, A. 1953 Catálogo de los artrópodos de las clases Arachnida e Insecta, encontrados en el hombre, los animales y las plantas de la República de Colombia. III. *Acta Agron., Palmira*, **3**, pt. 1, pp. 1–7.

Furman, D.P.; and Tarshis, I.B. 1953 Mites of the genera *Myialges* and *Microlichus* from avian and insect hosts. *Jl. of Parasitology*, **39**, pt. 1, pp. 70–78.

Gil Collado, J. 1937 Sur le parasitisme de quelques Arthropodes de l'Espagne. *C.R. XIIe Congr. Internat. Zool., Lisbonne*, (1935), **3**, pp. 2061–2064.

1948 El melófago o falso piojo de las ovejas. *Agricultura, Madrid*, **17**, No. 198, pp. 450–453.

Gimingham, C.T. 1937 *Crataerina pallida* Latr., a parasite of the swift. *Proc. Ent. Soc. London, Sect. A*, **12**, pts. 10–12, p. 135.

Giovannoni, M.; Mello, M.J. de; and Nobrega, P. 1952 Ensaio de transmissão da toxoplasmose por insetos hematófagos. *Arq. Inst. Biol., São Paulo*, **21**, (1952–1954), No. 1, pp. 1–4.

Gleiser, C.A., and Yager, R.H. 1946 Trichomonad and *Haemoproteus* infections. *Bull. U.S. Army Med. Dept.*, **6**, No. 2, pp. 177–182.

Gouin, F. 1950 Evolution de la région clypéo-cibariale chez les Diptères brachycères. *Proc. VIIIth Intern. Ent. Congr., Stockholm*, (1948), pp. 554–556.

Gregson, J.D. 1953 Control of livestock insects in British Columbia by the new organic insecticides. *Proc. 7th Pacific Sci Congr., (New Zealand, 1949)*, **4**, pp. 185–188.

Gressitt, S.L. 1955 *Olfersia aenescens* Thompson. *Proc. Hawaiian Ent. Soc.*, **15**, No. 3, p. 375.

Handlirsch, A. 1920–1925 Systematisches Uebersicht. In *Schröder, Handbuch der Entomologie*, **3**, pp. 377–1143. (Hippoboscidae, pt. 18, 1925, pp. 1028–1030).

Hardy, D.E. 1954 *Prosthetochaeta fasciata* Grimshaw. *Proc. Hawaiian Ent. Soc.*, **15**, No. 2, p. 290.

Hare, J. E. 1953 Bionomics of *Lipoptena depressa* (Say), the common louse fly of deer in western North America. *Microentomology*, **18**, pt. 2, pp. 38–51, 3 Pls. (figs. 16–18).

Hausmann, — 1950 Therapeutische Anwendung von Schafläusen bei Hepatitis epid. *Mediz. Klinik, Berlin-Munich-Vienna*, **45**, p. 31.

Hedeen, R.A. 1953 Ectoparasites occurring on mammals in the vicinity of Fort Hood, Texas. *Texas Jl. Sci.*, **5**, pt. 1 pp. 125–129.

Hennig, W. 1952 Die Larvenformen der Dipteren. 3. Teil. (Berlin), viii + 628 pp., 31 Pls. (Hippoboscidae: pp. 400–403).

Henry, M. 1945 The sheep ked. *Australian Vet. Jl.*, **21**, Nos. 5–6, p. 157.

Herman, C.M.; and Rosen, M.N. 1949 Disease investigations on mammals and birds by the California Division of Fish and Game. *California Fish Game*, **35**, pt. 3, pp. 193–201.

Herweijer, C.H. 1948 Onderzoek bestrijding van luisvliegen. *Nederl.-Indische Bladen Diergeneesk. Dierent.*, **55**, pts. 3–4, pp. 225–226.

Hightower, B.G.; Lehman, V.W.; and Eads, R.B. 1953 Ectoparasites from mammals and birds on a quail preserve. *Jl. of Mammalogy*, **34**, pp. 268–271.

Hill, R.E.; Hixson, E.; and Harris, L. 1954 Feeder lambs gain despite ticks. *Nebraska Agric. Expt. Sta. Q.*, **3**, *Summer Issue*, pp. 8–9.

Hill, R.E.; Hixson, E.; and Muma, M.H. 1950 Sheep tick control. *Nebraska Agric. Expt. Sta., Ann. Rept.*, **63**, p. 78.

Hindwood, K.A. 1952 Kookaburras and louse-flies. *The Emu*, **52**, p. 221.

Hiregaudar, L.S.; and Khambata, F.S. 1954 A record of mallophagan phoresy by *Pseudolynchia canariensis*. *Current Science, Bangalore*, **23**, p. 335.

Hoekstra, P. 1947 Proef ter verdelging van *Hipobosca* spec. (luisvlieg) by paarden met Shell Vetox. *Nederl. Ind. Bladen v. Diergeneeskunde*, **54**, pts. 3–4, pp. 95–97.

Hoffman, R.A. 1955 Longevity and emergence of the sheep ked. *Jl. Econ. Entom.*, **48**, p. 629.

Howard, H. 1955 The Los Angeles County Museum acquires Georg Statz Collection of fossils. *Bull. So. California Ac. Sci.*, **54**, pt. 2, p. 104.

Huff, C.G. 1931 Experimental transmission of an unusual *Haemoproteus* of mourning doves. *Jl. of Parasitology*, **18**, p. 122.

1942 Schizogony and gametocyte development in *Leucocytozoon simondi* and comparisons with *Plasmodium* and *Haemoproteus*. *Jl. Infect. Dis.*, **71**, pp. 18–32, 3 Pls.

Huitema, H. 1951 Een mogelijkheid voor de biologische bestrijding van luisvliegen. *Hemera Zoa*, **58**, pp. 443–453.

Hungerford, C.R. 1955 A preliminary evaluation of quail malaria in southern Arizona in relation to habitat and quail mortality. *Trans.* **20th** *North American Wildlife Confer.*, (*March, 1955*), pp. 209–219.

Imes, M.; and Babcock, O.G. 1943 Sheep ticks. *Sheep Goat Raiser*, **24**, No. 2, pp. 18–19 and 20.

Jackson, C.H.N. 1948 The eclosion of tsetse (*Glossina*) larvae. *Proc. Ent. Soc. London, Sec. A*, **23**, pts. 4–6, pp. 36–38, Pls. 1–8.

Jobling, B. 1949 Host-parasite relationship between the American Streblidae and the bats, with a new key to the American genera and a record of the Streblidae from Trinidad, British West Indies. *Parasitology*, **39**, pp. 315–329.

Kemper, H. 1952*a* ... Die Mauersegler-Lausfliege, Feind des Mauerseglers und Plage in menschlichen Wohnungen. *Natur und Volk*, **52**, pp. 404–408.

1952*b* Lausfliegen. *Entom. Colloquium*, No. **23**, 4 pp. (mimeographed).

1953 Ueber stechende Gliedertiere. *Schädlingsbekämpfung*, **45**, pp. 21–28.

1954 Beobachtungen an *Crataerina pallida*. *Verh. Deutsch. Ges. Angew. Entom., XII. Mitgl.-Vers.*, pp. 72–75.

Kemper, H.E. 1952 The control of external parasites of sheep. *Nation. Wool Grower*, **42**, pt. 7, pp. 21–23 and 39.

Kemper, H.E.; Cobbett, N.G.; and Peterson, H.O. 1953 Fluctuation of the ked population on sheep following shearing. *Veter. Medicine*, **48**, pp. 483–485.

Kemper, H.E.; Cobbett, N.G.; and Roberts, I.H. 1948 Test with benzene hexachloride for the destruction of coexistent infestations of the foot louse and keds on sheep. *North American Veter.*, **29**, No. 7, pp. 422–424.

Kemper, H.E.; and Peterson, H.O. 1953 The sheep tick and its eradication. *U.S. Dept. Agric., Farmers' Bull.* **2057**, 22 pp.

Kettle, D.S.; and Utsi, M.N.P. 1955 *Hypoderma diana* and *Lipoptena cervi* as parasites of reindeer (*Rangifer tarandus*) in Scotland. *Parasitology*, **45**, pts. 1–2, pp. 116–120.

***Kluz, —** 1950 (*Crataerina pallida* and *Stenepteryx hirundinis* in Czechoslovakia). *Sylvia*, **11–12**, pp. 37–51.

Knipling, E.F. 1951 The new insecticides for controlling external parasites of livestock. *U.S. Dept. Agric., Agric. Res. Admin., Bur. Entom. Plant. Quar.*, **E-762**, (2nd Revision), 28 pp.

1952 Benefits of ectoparasite control on livestock. *Proc. Amer. Assoc. Econ. Entom., North Central States Br.*, **7**, pp. 38–40.

Knowlton, G.F. 1953 Parasites on quail. *Bull. Brooklyn Ent. Soc.*, **48**, p. 19.

Knowlton, G.F.; Keetch, R.R.; and Binns, W. 1952 Controlling the sheep tick. *Utah State Agric. Coll., Ext. Circ.* **156**, 2 pp.

Kock, P. 1942 Zur Parasitenbefall des Rehwildes. *Deutsch. Tierärztl. Wochenschr.*, **50**, No. 3–4, pp. 36–38.

Koford, C.B. 1953 The California condor. *National Audubon Soc., Res. Rept. No.* **4**, 154 pp., Pls. (Occurrence of unidentified hippoboscid: p. 125).

Kraneveld, F.C.; and Mansjoer, M. 1952 Onderzoekingen over bloedparasieten. VI. Enkele gegevens over *Haemoproteus*-infecties bij *Columba livia* (*C. domestica*) in Indonesia. *Hemera Zoa*, **59**, Nos. 7–8, pp. 383–388.

Krauss, N.L.H. 1953 Insects and other invertebrates from Palmyra Atoll and Christmas Island. *Proc. Hawaiian Ent. Soc.*, **15**, pt. 1, pp. 217–220.

Lambrecht, K. 1933 Handbuch der Palaeornithologie. (Berlin), xix + 1024 pp.

Lameere, A. 1938 Précis de Zoologie. Vol. 5. Les insectes supérieurs. (Liege), 536 pp.

Latreille, P.A. 1802–1805 Histoire naturelle, générale et particulière, des Crustacés et des Insectes. (Paris), 14 vols. The following contain Hippoboscidae: vol. **2**, 1802 (An X), 380 pp.; vol. **3**, 1802 (An X), xii + 468 pp.; vol. **14**, 1805 (An XIII), 432 pp., Pls. 104–112.

1806–1809 Genera Crustaceorum et Insectorum secundum ordinem naturalem in familias disposita, iconibus exemplisque plurimis explicata. (Paris and Argentat), 4 vols. The following contains Hippoboscidae: vol. **4**, 1809, 399 pp., 16 Pls.

1817 Les Crustacés, les Arachnides et les Insectes. In *Cuvier, Le Règne Animal*, vol. 3, xxix + 653 pp.

1829 Suite et fin des Insectes. In *Cuvier, Le Règne Animal*, 2nd Ed., vol. **5**, xxiv + 556 pp.

Leach, W.E. 1817*c* Zoological Miscellany. (London), vol. 3, 151 pp., Pls. 121–149.

Legendre, R. 1952 Les adaptations morphologiques au parasitisme chez *Crataerhina pallida* Latr. *Annales Universitatis Saraviensis,* **1**, No. 2, pp. 118–121.

Linnaeus, C. 1758 Systema Naturae per regna tria naturae secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymicis, locis. (Stockholm), 10th Ed., **1**, 824 pp.

Linsdale, J.M.; and Tomich, P.O. 1953 A herd of mule deer. A record of observations made on the Hastings Natural History Reservation. (Berkeley and Los Angeles), xiii + 567 pp.

Longhurst, W.M.; and Douglas, J.R. 1953 Parasite interrelationships of domestic sheep and Columbian black-tailed deer. *Trans.* **18th** *North Amer. Wildlife Confer.,* pp. 168–188.

Loria, J.V.V. 1944 La *Pseudolynchia maura* (Bigot) o "mosca de los palomares." *Almanaque Min. Agric. Nación Argentina,* **19**, pp. 209–211.

McClure, H.E. 1943 Ecology and management of the mourning dove, *Zenaidura macroura* (Linn.) in Cass County, Iowa. *Iowa Agric. Expt. Sta., Research Bull. No.* **310**, pp. 355–415.

McKenna, C.T.; and Fearn, J.T. 1952 (Continued, *Op. cit.,* pp. 441–449).

McLintock, J.; and Depner, K.R. 1954 A review of the life-history and habits of the horn-fly, *Siphona irritans* (L.). *Canad. Entom.,* **86**, pp. 20–33.

Mail, G.A. 1940 (Also in a French edition: "Le pou du mouton," 3 pp.).

Manwell, R.D. 1955 The blood Protozoa of seventeen species of sparrows and other Fringillidae. *Jl. of Protozoology,* **2**, No. 1, pp. 21–27. (*Ornithoica vicina* and *Ornithomyia fringillina:* p. 26).

***Markov, A.A.** 1940 (Seasonal and annual variations of the starling parasite fauna in connection with changes in meteorological factors). *Zool. Zhurnal,* **19**, pt. 5, pp. 741–750. (In Russian. *Ornithomyia chloropus:* p. 743).

Marsh, H. 1950*a* Parasites of sheep in Australia. *National Wool Grower,* **40**, No. 1, pp. 28–29.

1950*b* Cattle and sheep disease in Australia. *Jl. Amer. Vet. Med. Assoc.,* **96**, pp. 298–299.

Marshall, J.T., Jr. 1951 Vertebrate ecology of Arno Atoll, Marshall Islands. *Atoll Research Bull., No.* **3**, 38 pp. (mimeographed).

Massonnat, E. 1910 Un nouvel hôte de *Lynchia maura. C. R. Soc. Biol., Paris,* **68**, pp. 430–432.

Meeser, M.J.M. 1952 A preliminary survey of the endo- and ectoparasites of the impala, *Aepyceros melampus. Jl. South African Vet. Med. Assoc.,* **23**, No. 4, pp. 221–223.

Menon, P.B. 1955 Some observations on the biology of *Hippobosca* species, with special reference to the pupal period. *Proc. Indian Sci. Congr. Assoc.,* **42**, Pt. 3, *Abstracts,* p. 293.

Moreno, J.J. 1945 Garrapata de los lanares (*Melophagus ovinus*). *Almanaque Min. Agric. Nación Argentina,* **20**, p. 287. (Also: 1946, *Campo y Suelo Argent.,* **30**, No. 351, p. 6).

Morris, W.E.; Parten, H.L.; and Griffiths, H.J. 1950 Livestock pest control. *Minnesota Univ., Div. Agric. Ext., Ext. Folder* **147**, 8 pp.

Moul, E.T. 1954 Preliminary report on land mammals on Onotoa Atoll, Gilbert Islands. *Atoll Research Bull.,* No. **28**, 28 pp. (mimeographed).

Münch, W. 1950 Therapeutische Anwendung von Schafläusen bei Hepatitis epid. *Mediz. Klinik, Berlin-Munich-Vienna,* **45**, p. 31.

Muir, F. 1912 Two new species of *Ascodipteron. Bull. Mus. Comp. Zool.,* **54**, pp. 349–366, Pls. 1–2.

Muma, M.H. 1946 Sheep tick control. *Nebraska Coll. Agric., Ext. Circ.* **1539**, (lithoprinted), [3 unnumbered pages].

Muma, M.H.; Hixson, E.; and Hill, R.E. 1950 Methods of sampling livestock parasite populations. *Proc. Amer. Assoc. Econ. Entom., North Central States Br.*, 5, pp. 18–19.

Nair, S.R. 1926 A preliminary note on the binomics of the pigeon fly, *Lynchia maura* Bigot. *Proc.* **13th** *Indian Sci. Congr., (Bombay, Jan. 4–7)*, p. 190.

Nelson, W.A. 1953 The relationship between infestation of feedlot lambs with the sheep ked (*Melophagus ovinus* L.) and the nutritional status of the lambs. *Agric. Inst. Rev., Ottawa*, 8, pt. 3, p. 34. (Also in: *Proc. Canadian Soc. Anim. Prod.*, 1953, pp. [17]–[18], mimeographed).

1955 Artificial feeding of certain ectoparasites through membranes. *Jl. of Parasitology*, 41, pt. 6, pp. 635–636.

Nelson, W.A.; and Slen, S.B. 1953 Note on evaluating populations of the sheep ked, *Melophagus ovinus* (L), on feeder lambs. *Canadian Jl. Agric. Sci.*, 33, pp. 620–621.

Newman, E. 1834 Attempted division of British insects into natural orders. *Entom. Mag.*, 2, pp. 379–431.

Nielsen, P.; Ringdahl, O.; and Tuxen, S.L. 1954 Diptera 1. (exclusive of Ceratopogonidae and Chironomidae). In: *The Zoology of Iceland*, 3, pt. 48*a*, pp. 1–189. (Hippoboscidae: pp. 140–141).

Nuorteva, P. 1950 (*Degeeriella glandarii* attached to *Ornithomyia fringillina* on *Garrulus glandarius* in Finland). *Annales Entom. Fennici*, 16, pt. 1, pp. 34 and 38.

Owen, D.F. 1953 *Ornithomya fringilla* Curt. on redwing. *Entom. Record*, 65, p. 31.

Paramonov, S.J. 1954 Notes on Australian Diptera. XIV. Notes on some hippoboscids (especially *Ortholfersia*). *Ann. Mag. Nat. Hist.*, (12), 7, pp. 283–292.

Parmalee, P.W. 1952 Ecto- and endoparasites of the bobwhite: their numbers, species and possible importance in the health and vigor of quail. *Trans.* **17th** *North Amer. Wildlife Confer.*, pp. 174–188.

Parmalee, P.W.; and Price, M.A. 1953 *Bruellia illustris* (Kellogg) and other ectoparasites from the bobwhite quail in Texas. *Jl. of Parasitology*, 39, pp. 222–223.

Parmenter, L. 1953 *Ornithomyia fringillina* Curt. on a robin in Kent. *Entom. Record*, 65, p. 93.

Pfadt, R.E.; and DeFoliart, G.R. 1952 Control of sheep ked by dusting. *Wyoming Agric. Expt. Sta., Mimeogr. Circ.* 23, 8 pp.

Pfadt, R.E.; Paules, L.H.; and DeFoliart, G.R. 1953 Effect of the sheep ked on weight gains of feeder lambs. *Jl. Econ. Entom.*, 46, pp. 95–99.

Pfadt, R.E.; and Ryff, J.F. 1955 Safe use of dieldrin dust for sheep ked control. *Jl. Econ. Entom.*, 48, pp. 195–198.

Philip, C.B. 1956 Comments on the classification of the Rickettsiales. *Canadian Jl. Microbiology*, 2, pp. 261–270. (*Wolbachia melophagi*, p. 266).

Pilgrim, G.E. 1941 The dispersal of the Artiodactyla. *Biol. Reviews Cambridge Phil. Soc.*, 16, pp. 134–163.

Poisson, H. 1931 Note sur un Diptère parasite des pigeons. *Bull. Soc. Path. Exot., Paris*, 24, pp. 358–359.

Povolný, D.; and Rosický, B. 1955 (Faunistisch-bionomische Uebersicht der Hippobosciden aus dem Gebiete der ČSR). *Zoolog. Entom. Listy, Prague*, 4, No. 1, pp. 5–20, Pls. 1–2. (In Czech).

Pratt, E. A. 1952 Keds, lice and mites in sheep. *New Zealand Jl. Agric.*, 85, pp. 209 and 211–212.

***Proppe, G.J.** 1924 Bestrijding van de *Hippobosca*. *Nederl.-Indische Bladen Diergeneesk. Dierent.*, 35, pp. 419–420.

Quecke, K. 1951 Die Behandlung der Gelbsucht mit Schafläusen. Ein

historischer Ueberblick. *Mediz. Monatsschr., Stuttgart*, **5**, No. 5, pp. 357–361.

Rausch, L. 1948–1949 Ueber die therapeutische Verwendung von Schafsläusen bei Ikterus. *Klinische Wochenschr., Berlin*, **26**, 1948, Nos. 29–30, pp. 475–476; **27**, 1949, Nos. 35–36, pp. 607–608.

Reyes, R.V. 1947 Artrópodos de interés médico-veterinario comprobados en Colombia. *Rev. Grancolombiana Zoot. Hig. Med. Vet., Caracas*, **1**, Nos. 10–12, pp. 698–721. (Also in: *Rev. Med. Vet., Bogotá*, **17**, No. 96, 1948, pp. 68–80).

Rivero, M.D.; and Ramirez, E. 1940 La infección por el *Haemoproteus columbae* en la investigación de la actividad antimalárica. *Rev. Inst. Salubr. Enfermed. Tropic., México*, **1**, pp. 245–264.

Robb, T.R. 1951 New method in battling old enemy: Wyoming sheepmen use modern way of controlling sheep tick to cut losses in herd. *Rec. Stockman, Annual Ed., (for 1952)*, pp. 222 and 224.

Roberts, F.H.S. 1952 Insects affecting livestock; with special reference to important species occurring in Australia. (Sydney), vii + 267 pp.

Rude, C.S.; and Parish, H.E. 1946 Control of the sheep tick by a single dipping in DDT emulsion. *U.S. Bur. Ent. Plant Quarant.*, **E-679**, (mimeographed), 2 pp.

Samouelle, G. 1819 The entomologist's useful compendium, or an introduction to the knowledge of British insects. (London), 496 pp., 12 Pls. (First use of family name Hippoboscidae, p. 302, to include *Hippobosca, Ornithomyia, Craterina, Oxypterum* and *Melophagus*).

Schiner, J.R. 1853 Dipterologische Fragmente. III. *Verh. Zool.-Bot. Ver. Wien*, **3**, *Abhandl.*, pp. 151–154.

1864*b* Ein neues System der Dipteren. *Verh. Zool.-Bot. Ges. Wien*, **14**, *Abhandl.*, pp. 201–212.

Schuurmans-Stekhoven, J.H., Jr. 1923*b* (Title in Pt. I: appeared first in *Nederl.-Indische Bladen Diergeneesk. Dierent.*, **35**, pts. 2–3, pp. 103–144, 1 Pl.).

1954*a* De biologie van de luisvlieg van de duif (*Pseudolynchia canariensis* Macquart). *Entom. Ber. Nederl. Ent. Ver.*, **15**, No. 2, pp. 24–25.

1954*b* Biologische Beobachtungen an *Stenepteryx hirundinis* L. *Zeitschr. f. Parasitenk.*, **16**, pt. 4, pp. 313–321.

1955 Tweevleugelige Insecten, Diptera. III. Luisvliegen (Nycteribiidae en Hippoboscidae). *Kon. Nederland. Natuurhist. Vereen., Wetensch. Meded., No.* **16**, 16 pp.

Schuurmans-Stekhoven, J.H., Jr.; Silva, I.I.; and San Roman, P. 1954 Zur Biologie der Taubenlausfliege. *Zeitschr. f. Parasitenk.*, **16**, pts. 5–6, pp. 388–406.

1956 Die Biologie der Taubenlausfliege. Bewegungsphysiologie, Taxismen und Zirkulation des Blutes. *Zool. Jahrb., Abt. Physiol.*, **66**, pt. 4, pp. 509–530.

Seghetti, L. 1951 Sheep tick control. *Montana Wool Grower*, **25**, No. 4, p. 9.

Seghetti, L.; and Corkins, J.P. 1953 Control of sheep ticks. *Montana State Coll., Ext. Leaflet* **M-1**, (revised), 6 pp.

Séguy, E. 1950 Phorésie et rôle pathogène chez les Insectes Diptères. *Eos, Special Volume*, pp. 315–324.

1955 Introduction à l'étude biologique et morphologique des Insectes Diptères. *Publ. Avulsas Mus. Nacion., Rio de Janeiro*, pp. 1–260.

Sheldon, W.G.; Shaw, F.R.; and Bartlett, L.B. 1956 New records of hippoboscids on woodcock. *Proc. Ent. Soc. Washington*, **58**, No. 1, p. 13.

Shipley, A.E. 1911*b* Grouse disease. *Science Progress in 20th Century*, **5**, (1910–1911), No. 20, pp. 565–583. (Reprint, London, 1911, 15 pp.).

1917 Studies in insect life and other essays. (London), xi + 338 pp. (Grouse disease: pp. 189–221).

Simpson, C.F.; and Swarthout, E.W. 1954 *Haemoproteus columbae* infection in Florida pigeons. *Veter. Medicine*, **49**, pp. 491 and 494.

Simpson, G.L. 1953 The major features of evolution. (New York), xx + 434 pp.

Smart, J. 1945 Ked-flies. *Nature, London*, **155**, No. 3926, p. 123.

Snodgrass, R.E. 1944 The feeding apparatus of biting and sucking insects affecting man and animals. *Smithson. Misc. Coll.*, **104**, No. 7, pp. 1–113.

1953 The metamorphosis of a fly's head. *Smithson. Misc. Coll.*, **122**, No. 3, pp. 1–25.

Soetisno, M. 1928 Een vijand der luisvliegen. *Nederl.-Indische Bladen Diergeneesk. Dierenteelt*, **40**, pp. 231–232.

Stansfield, G. 1955 Flat-fly infestation in the pipits and wheatears of Skokholm in 1954. *Fair Isle Bird Obs. Bull.*, **2**, No. 7, pp. 318–320.

Statz, G. 1941 Plagegeister aus dem rheinischen Braunkohlenwalde. *Rheinischer Naturfreund*, **5**, No. 1; (reprint, pp. 1–16).

Stephen, A.C. 1953 Magnificent frigate-bird in Scotland. *Scottish Naturalist*, **65**, No. 3, pp. 193–194. Postscript by the Editors, p. 156. (*Olfersia spinifera*).

Stevenson, A.C. 1922 [Negri-like bodies in cells of the sheep-ked]. *Trans. R. Soc. Trop. Med. Hyg.*, **16**, pts. 1–2, p. 19.

Stirling, W.T. 1953 Further records of *Crataerina pallida* (Latr.) in Scotland. *Scottish Naturalist*, **65**, No. 3, p. 192.

Strickland, E.H. 1953 The ptilinal armature of flies (Diptera Schizophora). *Canadian Jl. Zool.*, **31**, No. 3, pp. 263–299.

Tarshis, I.B. 1953*a* Oöcyst-like bodies in the midgut of *Stilbometopa impressa* (Bigot). *Science*, **118**, pp. 199–202.

1953*b* The transmission of *Haemoproteus lophortyx* O'Roke of the valley California quail by hippoboscid flies of the species *Stilbometopa impressa* (Bigot) and *Lynchia hirsuta* Ferris and elucidation of the biology of these ectoparasites. (*Summary of Dissertation, Berkeley*), 1 p.

1954 Transporting live hippoboscids. Psyche, **61**, pp. 58–62.

1955 Transmission of *Haemoproteus lophortyx* O'Roke of the California quail by hippoboscid flies of the species *Stilbometopa impressa* (Bigot) and *Lynchia hirsuta* Ferris. *Experimental Parasitology*, **4**, No. 5, pp. 464–492.

Tendeiro, J. 1950 Subsídios para o conhecimento da entomofauna parasitária de Moçambique. *Anais Junta Investigações Coloniais, Lisboa*, **4**, pt. 2, pp. 123–152, Pls. 1–2.

Théodoridès, J. 1954 Première contribution à l'étude des ectoparasites des Vertébrés des Pyrénées-Orientales. *Vie et Milieu, Paris*, **4**, (for 1953), pt. 4, pp. 753–756.

Thompson, G.B. 1953*a* Contributions toward a study of the ectoparasites of British birds and mammals. No. 1. *Ann. Mag. Nat. Hist.*, (12), **6**, pp. 401–425.

1953*b* The parasites of British birds and mammals. XXV. Additional notes on *Crataerina pallida* (Latr.). *Ent. Mo. Mag.*, **89**, pp. 208–209.

1954*a* Contributions towards a study of the ectoparasites of British birds and mammals. No. 2. *Ann. Mag. Nat. Hist.*, (12), **7**, pp. 17–39.

1954*b* Contributions toward a study of the ectoparasites of British birds and mammals. No. 3. *Ann. Mag. Nat. Hist.*, (12), **7**, pp. 438–447.

1955*a* The parasites of British birds and mammals. XXVIII. Records of *Ornithomya* spp. collected during 1952. *Ent. Mo. Mag.*, **91**, pp. 4–5.

1955*b* Contributions toward a study of the ectoparasites of British birds and mammals. No. 4. *Ann. Mag. Nat. Hist.*, (12), **8**, pp. 25–35.

1955*c* Ectoparasites from birds at Bardsey. *Bardsey Observatory*, (*1954 Rept.*), p. 11.

1955*d* The collection of bird ectoparasites at the bird observatories. *British Birds*, **48**, pp. 239–240.

1955*e* Ectoparasites. *Lundy Field Soc. Rept.*, (*for 1954*), pp. 30–31.

1955*f* Ectoparasites from Skokholm Bird Observatory. *Nature in Wales*, **1**, No. 3, pp. 128–130.

1955*g* Contributions toward a study of the ectoparasites of British birds and mammals. No. 5. *Ann. Mag. Nat. Hist.*, (12), **8**, pp. 724–730.

1955*h* Contributions towards a study of the ectoparasites of British birds and mammals. No. 6. *Ann. Mag. Nat. Hist.*, (12), **8**, pp. 917–927.

Trouessart, E.L. 1906 [First description of *Myialges anchora*]. *Bull. Soc. Zool. France*, **31**, No. 5, pp. 128–129.

Vogelsang, E.G. 1936 Contribución al estudio de la parasitología animal en Venezuela. V. Ectoparásitos. *Rev. de la Policlinica Caracas*, **6**, No. 31, pp. 2.122–2.124.

1953 Beiträge zur Kenntnis der Zooparasiten der Haus- und Wildtiere Venezuelas. *Deutsch. Tierärztl. Wochenschr.*, **60**, pp. 529–531.

Vorobev, M.M.; and Kishkar, P.M. 1954 (Controlling the sheep ked). *Karakulevodstvo i Zverovodstvo*, **7**, pp. 54–55. (In Russian).

Wahl, B. 1914 Ueber die postembryonale Entwicklung des Fliegenkopfes. *Verh. Zool.-Bot. Ges. Wien*, **64**, *Sitzungsber.*, pp. 202–205.

Ward, R.A. 1953 Additional record of phoresy of Mallophaga on Hippoboscidae. *Bull. Brooklyn Ent. Soc.*, **48**, p. 128.

Wasserburger, H.J. 1953 Versuche zur Schaflausfliegenbekämpfung. *Deutsch. Tierärztl. Wochenschr.*, **60**, pp. 475–476.

Waterhouse, D.F. 1953 The occurrence and significance of the peritrophic membrane, with special reference to adult Lepidoptera and Diptera. *Australian Jl. Zool.*, **1**, pt. 3, pp. 299–318, Pls. 1–2.

Westwood, J.O. 1839–1840 An introduction to the modern classification of insects. (London), vol. 1, 1839, xii + 462 pp., 1 Pl.; vol. 2, 1840, xi + 587 pp. and Generic Synopsis of 158 pp.

Whiting, F.; Nelson, W.A.; Slen, S.B.; and Bezeau, L.M. 1954 The effects of the sheep ked (*Melophagus ovinus* L.) on feeder lambs. *Canadian Jl. Agric. Sci.*, **34**, pp. 70–75.

Whittle, C.L. 1932 Are nesting territories always available for returning juvenile song sparrows? *Bird-Banding*, **3**, No. 3, pp. 106–108. (Hippoboscidae: p. 107).

Wigand, R.; and Hente, H. 1950 Ueber die therapeutische Verwendung der Schaflausfliege gegen Ikterus. *Hippokrates*, **21**, pp. 662–664.

Williamson, K. 1951 Bird ectoparasites. *Fair Isle Bird Observatory Bull.*, **1**, pp. 6–7.

1954 The Fair Isle apparatus for collecting bird ectoparasites. *British Birds*, **47**, pt. 7, pp. 234–235, Pl. 44.

Williamson, K.; and Thom, V.M. 1955 Red-footed falcon at Fair Isle. *British Birds*, **48**, pp. 542–543.

Wilms, F. 1950 Therapeutische Anwendung von Schafläusen bei Hepatitis epid. *Mediz. Klinik, Berlin-Munich-Vienna*, **45**, p. 31.

Woke, P.A.; Jacobs, L.; Jones, Frances E.; and Melton, Marjorie L. 1953 Experimental results of possible arthropod transmission of toxoplasmosis. *Jl. of Parasitology*, **39**, pp. 523–532.

Woodbury, E.N. 1943 Rearing insects affecting man and animals. *Amer. Assoc. Adv. Sci., Publ. No.* **20**, pp. 60–73. (*Melophagus ovinus:* pp. 72–73).

Woodcock, H.M. 1923 [Rickettsia-like bodies in the ked]. *Trans. R. Soc. Trop. Med. Hyg.*, **17**, pts. 1–2, pp. 4–5.

Woodroffe, G.E. 1953 An ecological study of the insects and mites in the

nests of certain birds in Britain. *Bull. Ent. Res.*, **44**, pt. 4, pp. 739–772, Pls. 14–16.

Wulp, F.M. van der; and Meijere, J.C.H. de 1898 Nieuwe naamlijst van Nederlandsche Diptera. *Tijdschr. v. Entom.*, **41**, *Supplement*, [6] + 149 pp. (Hippoboscidae: pp. 142–143).

Zimsen, Ella 1954 The insect types of C.R.W. Wiedemann in the Zoological Museum in Copenhagen. *Skrift. Univ. Zool. Mus., Copenhagen*, **14**, pp. 1–43. (Type of *Ornithomyia columbae:* p. 30).

ADDITIONS AND CORRECTIONS

Part I

(p. 13) Dr. Richard K. Benjamin informs me that he was not a Graduate Student when he did research work at the Biological Laboratories of Harvard University. He was at the time a National Research Fellow, having obtained his Doctor's degree earlier. I regret that I was under a misapprehension in this matter.

(p. 21) Fig. 5*C* is incorrect; a corrected drawing of the frontal area and antennae of *Ornithoica vicina* is given in Pt. II, Fig. 24*G* (p. 104).

(p. 22, line 12 from top) For "Hippobosciade," read "Hippoboscidae."

(pp. 28–29) Fig. 7*F* is incorrect; a corrected drawing of the frontal area and antennae of *Olfersia coriacea* is given in Pt. II, Fig. 84*B* (p. 421).

(p. 32, line 7 from bottom) For "medium notal suture," read "median notal suture."

(pp. 46–47) In the caption for Fig. 13*D*, for "1, 2, 3, and 4, first, second, third and fourth longitudinal veins," read "1, 2, 3 and 4, first, fourth, fifth and sixth longitudinal veins."

(p. 60, line 16 from top) Delete "*Ornithomyia laticornis* Macquart, 1835." This is not a synonym of *Ornithoctona erythrocephala.*

(p. 121, bottom line) For "15°17′ N.," read "51°17′ N."

(p. 124, line 6 from top) For "*M. ovinus* is the hippoboscid which reaches," read "*M. ovinus* is one of 2 hippoboscids which reach."

(p. 138, line 8 from bottom) For "*sacharowi*," read "*sacharovi.*"

(p. 141, lines 1 and 2 from top) For "*Anhinga r. rufa*," read "*Anhinga anhinga rufa.*"

(pp. 140–141) Laboulbeniales of the genus *Trenomyces* have been observed recently also on *Lynchia holoptera, Olfersia sordida,* and *O. coriacea.* These fungi were all seen by Dr. R.K. Benjamin.

(pp. 142–149) Valuable observations on the mites attacking hippoboscids have been published recently by Dubinin (1953) and by Furman and Tarshis (1953).

(p. 147, line 20 from bottom) For "Waterston," read "Warburton."

(p. 160, line 23 from top) For "*haliaeëtus*," read "*haliaetus.*"

(p. 161) The name *Mormoniella vitripennis* (Walker) should be corrected to *Nasonia vitripennis* (Walker), as explained in Pt. II, p. 403.

(p. 167, last sentence of first paragraph) Mr. G.H.E. Hopkins called my attention to the fact that *Hohorstiella* belongs in the Amblycera, so that the generalization of this sentence is invalid.

(p. 194, third paragraph) The sentence referring to the puparium of *Lynchia albipennis* should be deleted. See Pt. II, p. 341, footnote.

(p. 216, lines 3 and 4 from bottom) Delete "a louse occurring normally on the European robin, *Turdus merula.*"

(pp. 238–239) The discussion of *Lynchia americana* and *L. fusca* should be emended, as these two names are now referred to one species. See Pt. II, pp. 297–299.

(p. 249, line 14 from bottom) For "marine," read "aquatic."

(p. 252, line 13 from top) For "*Theresticus,*" read "*Theristicus.*"

(p. 252, line 6 from bottom) For "*massonati,*" read "*massonnati.*"

(p. 270, line 8 from top) For "strictly," read "frequently." Mr. G.H.E. Hopkins informed me that some of the Alcedinidae, such as *Dacelo, Ceyx, Lacedo* and *Todiramphus,* are insectivorous. *Dacelo* also eats snakes and lizards. The fact may be of some importance for the host-parasite relations, as the hippoboscids known at present from Alcedinidae were taken only on the genera which do not eat fish.

(p. 279, line 12 from top) For "*Tachyphorus,*" read "*Tachyphonus.*"

(p. 321) Delete *Lynchia fusca* from the group of pleioxenous hippoboscids, as it is a synonym of the polyxenous *L. americana* discussed on p. 323.

(p. 345) Add to the hippoboscids definitely known to bite Man in nature: *Olfersia aenescens* C.G. Thomson and *O. fossulata* Macquart, as mentioned in Pt. II for these species.

(p. 327, line 2 from bottom) For "*Ornithomyia remota,*" read "*Ornithomyia parva* (=*remota*)." The name should be corrected wherever it occurs.

(p. 368, line 15 from top) For "1905," read "1904–1905." The pages of this work covering the Hippoboscidae were published Dec. 1, 1904.

(p. 373, line 14 from top) For "1944*b*," read "1943;" but the paper with the same title in the *Wyoming Wool-Grower* appeared in 1944.

(p. 385, lines 16 and 18 from bottom) For "*Papeis,*" read "*Papéis.*"

(p. 397, lines 20 and 28 from bottom) For "Massonat," read "Massonnat." This name was misspelled throughout Pt. I and should be corrected wherever it occurs.

(p. 399, line 14 from top) For "Morey," read "Morley."

(p. 408, line 6 from top) For "128–220," read "127–223."

Part II

(p. 6) Dr. C.W. Sabrosky pointed out to me that the earliest use of the family term Hippoboscidae for the true louse-flies was by Samouelle (1819, pp. 302–303), who included in it *Hippobosca, Ornithomyia, Craterina, Oxypterum* and *Melophagus.* He placed *Nycteribia* in a distinct family Nycteribiidae. Both these families he placed in the Omaloptera of Leach.

(p. 18) Add to the characters of the Ortholfersiinae: "Arista of antenna long, thin, seta-like, undivided."

(p. 22, line 12 from top) For "ellipical," read "elliptical."

(p. 22) The first entry of couplet 14 in the key, leading to *Hippobosca,* should read: "Anterior margin of thorax seen from above broadly rounded off at the sides."

(pp. 93–100) Additional specimens examined of *Ornithoica vicina.* MASSACHUSETTS: Cotuit, Barnstable Co., on *Melospiza m. melodia,* Sept. 19 (B. Shreve). — NEW JERSEY: 3 miles N. of New Brunswick, on *Pipilo e. erythrophthalmus,* Sept. (J. Baird). — TENNESSEE: Nashville, Davidson Co., on *Pipilo e. erythrophthalmus,* Nov. 1 (Mrs. A.R. Laskey). — WEST VIRGINIA: 3 miles N. of Arbovale, Pocahontas Co., 2 ♀ on *Lanius ludovicianus migrans,* Aug. 12; this bird also harboring 7 *Ornithomyia fringillina* (K.C. Parkes). — MEXICO: El Ocote, Ocozocoautla, State Chiapas, on *Otus g. guatemalae* (M. Alvarez del Toro). — BRITISH HONDURAS: Maya Mts., on *Ciccaba nigrolineata* (S.M. Russell). — PANAMA: Cerro Picacho, Chiriqui Prov., 6200 ft., on *Myiodynastes hemichrysus* (G. Hartmann and A. Wetmore). — COLOMBIA: La Candela, Dept. Huila, on *Ciccaba v. virgata* (M.A. Carriker, Jr.). — BRAZIL: Nova Teutonia, Itá, State Santa Catharina, on *Glaucidium b. brasilianum* (F. Plaumann). — BOLIVIA: Ipirana, South Yungas, on *Tyto alba tuidara* (Kunzel and Niethammer).

(pp. 100–102) Add to list of Nearctic hosts under Passeriformes: *Lanius ludovicianus migrans* (1).

(p. 102) Add to list of Neotropical hosts under Strigiformes: *Ciccaba*

nigrolineata (1); *C. v. virgata* (1); *Glaucidium b. brasilianum* (1); *Otus g. guatemalae* (1); *Tyto alba tuidara* (1). Under Passeriformes: *Myiodynastes hemichrysus* (1).

(p. 122) Add to the references of *Ornithomyia fringillina:* Sheldon, Shaw, and Bartlett, 1956, Proc. Ent. Soc. Washington, **58**, p. 13 (Massachusetts: Prescott Peninsula area of Quabin Reservoir, near Shutesbury, on *Philohela minor*).

(pp. 125–133) Additional specimens examined of *Ornithomyia fringillina.* Alaska: Dot Lake Lodge, between Tok and Delta Junction, about 63°30′ N., 144° W., Aug. 31, without host (W.H. Coleman). — Maine: Waterville, Kennebec Co., on a warbler, Sept. 13 (D. Crocker). — Massachusetts: Prescott Peninsula, Quabin Reservoir, Shutesbury, Hampshire Co., 2 ♀ on *Philohela minor,* Aug. 15–16 (L.M. Bartlett. — Also recorded by Sheldon, Shaw and Bartlett, 1956). — New Jersey: 3 miles N. of New Brunswick, on *Cyanocitta c. cristata,* Sept. (J. Baird). — West Virginia: 3 miles N. of Arbovale, Pocahontas Co., on *Lanius ludovicianus migrans,* Aug. 12, 7 ♀; 3 or 4 more flies escaped from this bird (K.C. Parkes). — Wisconsin: Cedar Grove, Sheboygan Co., Sept. 22, on *Accipiter striatus velox* (D.D. Berger).— Also Massachusetts: Groton, Middlesex Co., on *Passerina cyanea,* Sept. 11 (W.P. Wharton); Weymouth, Norfolk Co., on *Molothrus a. ater,* Sept. 9 (R.E. Wheeler).

(p. 136) Add to list of hosts under Passeriformes: *Lanius ludovicianus migrans* (1); *Passerina cyanea* (1).

(p. 141, line 3 from bottom) For "*Pipilo fuscus falcifer,*" read "*Pipilo maculatus falcifer.*"

(p. 156) Additional record of *Ornithomyia* (*Pseudornithomyia*) *ambigua* (Lutz, Neiva and da Costa Lima). Colombia: Belén, Dept. Huila, 6300 ft., on *Notiochelidon c. cyanoleuca* (M.A. Carriker, Jr.)

(p. 162) Add to the synonymy of *Crataerina: Crathaerrhyna* Beklemishev, 1954, Med. Parazitol. i Parazitarnye Bolezni, **1**, p. 9 (error for *Crataerina*).

(pp. 190–197) Additional specimens examined of *Ornithoctona erythrocephala.* Mexico: Laguna Ocotal, State Chiapas, on *Penelope p. purpurascens,* 4 *Ortalis v. vetula, Hypomorphnus urubitinga ridgwayi,* and *Micrastur semitorquatus naso* (R.A. Paynter, Jr.); Rancho Nuevo Mundo, Pueblo Nuevo Solistahuacán, State Chiapas, 1900 m., on *Pharomachrus m. mocino* (M. Alvarez del Toro); El Ocote, Ocozocoautla, State Chiapas, on *Oreopeleia m. montana* (M. Alvarez del Toro). — Panama: Palo Santo, Chiriqui Prov., on *Buteo p. platypterus* (G. Hartmann and A. Wetmore); Santa Clara, Chiriqui Prov., on *Odontophorus guianensis castigatus* (G. Hartman and A. Wetmore). — Jamaica: Clydesdale, St. Andrew, on Man (A.M. Wiles); Second Breakfast Spring, St. Andrew, in flight (T.H. Farr); Deanery, St. Catherine, ♀ with 10 ♀ mites, without eggs, fixed on the gula, in the rostrum membrane behind the haustellum and ♂ with 1 ♀ mite, without eggs, in the same position, on *Columba i. inornata.* — Colombia: Tyeros (Moscopán), Dept. Huila, on *Herpetotheres c. cachinnans* (M.A. Carriker, Jr.); Hacienda Potreros, 15 miles S.W. of Frontino, Dept. Antioquia, on *Columba subvinacea bogotensis* (M.A. Carriker, Jr.); La Candela, Dept. Huila, on *Odontophorus hyperythrus* (M.A. Carriker, Jr.); La Bodega, Dept. Antioquia, on *Momotus momota aequatorialis* (M.A. Carriker, Jr.). — Peru: Hacienda Taulis, 6°50′ S., 79°10′ W., 1700 m., on *Chondrohierax uncinatus* (Koepcke); Río Lurin, on *Falco sparverius peruvianus* (W. Weyrauch). — Bolivia: Irupana, 200 kilom. E. of La Paz, South Yungas, 2000 m., on *Columba a. albilinea,* and 6 ♀ and 1 ♂ on *Buteo brachyurus* (Kunzel and Niethammer). — Uruguay: Montevideo, on *Buteo magnirostris gularis* (L.P. Barattini); Rocha, on *Buteo magnirostris gularis* (L.P. Barattini). — Argentina: Pampa de los Guanacos, Santiago del Estero, near Roque Saenz Peña, on *Falco f. femoralis,* April 16 (J. Gomez). — Brazil: Nova Teutonia near Itá, State Santa Catharina, on *Circus cinereus* and *Columba rufina sylvestris* (F. Plaumann).

(p. 198) Add to list of Neotropical hosts under Falconiformes: *Buteo brachyurus* (1); *B. magnirostris gularis* (2); *B.p. platypterus* (1); *Chondrohierax uncinatus* (1); *Falco sparverius peruvianus* (1); *Hypomorphnus urubitinga ridgwayi* (1); *Micrastur semitorquatus naso* (1). Under Galliformes: *Odontophorus guianensis castigatus* (1); *O. hyperythrus* (1); *Ortalis v. vetula* (4); *Penelope p. purpurascens* (1). Under Columbiformes: *Columba subvinacea bogotensis* (1). Under Trogoniformes: *Momotus momota aequatorialis* (1). This raises the number of native Neotropical host species to 106 (34 Falconiformes, 12 Galliformes, and 22 Columbiformes). It would therefore appear that the Galliformes will have to be included among the true breeding hosts of *O. erythrocephala*, particularly in view of the fact that hippoboscids are difficult to obtain from such birds.

(pp. 212–216) Additional specimens examined of *Ornithoctona fusciventris*. MEXICO: Laguna Ocotal, State Chiapas, on *Icterus m. mesomelas*, *Piranga l. leucoptera*, and *Dendroica graciae decora* (R.A. Paynter, Jr.). — PANAMA: Cerro Punta, Chiriqui Prov., on *Dendrocopos villosus extimus* and *Pezopetes capitalis* (G. Hartmann and A. Wetmore); Santa Clara, Chiriqui Prov., on *Momotus m. momota* and *Odontophorus guianensis castigatus* (G. Hartmann and A. Wetmore); Silla de Cerro Pando, El Volcán, Chiriqui Prov., 5200 ft. on *Empidonax flaviventris* and *Myadestes ralloides melanops* (G. Hartmann and A. Wetmore); Palo Santo, Chiriqui Prov., on *Turdus grayi casius* (G. Hartmann and A. Wetmore); Chevo, Chiriqui Prov., on *Mitrephanes phaeocercus aurantiiventris* (G. Hartmann and A. Wetmore); El Volcán, Chiriqui Prov., on *Pharomachrus mocino costaricensis* (A. Wetmore). — COLOMBIA: Hacienda La Ellusión, above Urrao, 9000 ft., Dept. Antioquia, on *Atlapetes s. schistaceus* (M.A. Carriker, Jr.); Belén, Dept. Huila, 6400 ft., on *Anabacerthia s. striaticollis* (M.A. Carriker, Jr.); La Candela, Dept. Huila, on *Micrastur semitorquatus naso* and *Myiochanes fumigatus ardosiacus* (M.A. Carriker, Jr.); La Bodega, Dept. Antioquia, on *Calospiza l. labradorides* (M.A. Carriker, Jr.); Paramo de Sonson, Dept. Antioquia, 8500 ft., on *Myiotheretes s. striaticollis* and *Atlapetes s. schistaceus* (M.A. Carriker, Jr.); Purace, Dept. Cauca, 9000 ft., on *Leptotila p. plumbeiceps* (M.A. Carriker, Jr.) — PERU: Hacienda Taulis, 6°50′ S., 79°10′ W., 1700 m., Cajamarca, on *Atlapetes torquatus nigrifrons* (Koepcke). — BOLIVIA: Irupana, 200 kilom. E. of La Paz, South Yungas, 2000 m., on *Coryphospingus cucullatus fargoi* (Kunzel and Niethammer); Pojo, 150 kilom. E. of Cochabamba, Dept. Cochabamba, on *Poospiza t. torquata* (Niethammer).

(pp. 216–217) Add to list of Neotropical hosts under Falconiformes: *Micrastur semitorquatus naso* (1). Under Galliformes: *Odontophorus guianensis castigatus* (1). Under Coraciiformes: *Momotus m. momota* (1). Under Passeriformes: *Anabacerthia s. striaticollis* (1); *Atlapetes s. schistaceus* (2); *A. torquatus nigrifrons* (1); *Calospiza l. labradorides* (1); *Coryphospingus cucullatus fargoi* (1); *Dendroica graciae decora* (1); *Empidonax flaviventris* (1); *Icterus m. mesomelas* (1); *Mitrephanes phaeocercus aurantiiventris* (1); *Myadestes ralloides melanops* (1); *Myiochanes fumigatus ardosiacus* (1); *Myiotheretes s. striaticollis* (1); *Pezopetes capitalis* (1); *Poospiza t. torquata* (1); *Turdus grayi casius* (1). Columbiformes: *Leptotila p. plumbeiceps* (1). Trogoniformes: *Pharomachrus mocino costaricensis* (1). Piciformes: *Dendrocopos villosus extimus* (1). This raises the number of known Neotropical host species to 65 (2 Falconiformes; 2 Galliformes; 1 Columbiformis; 1 Trogoniformis; 1 Piciformis; and 58 Passeriformes), a further proof that passerine birds are the true breeding hosts of *O. fusciventris* (with 66 of 75 verified individual records).

(p. 225) Additional specimen examined of *Ornithoctona oxycera*. COLOMBIA: Cerro Munchique, Dept. Cauca, 7500 ft., on *Cnemotriccus p. poecilurus* (M.A. Carriker, Jr.).

This record adds one host species in Passeriformes: *Cnemotriccus poecilurus*.

(p. 228) Additional specimens examined of *Ornithoctona (Ornithopertha) nitens.* PANAMA: El Volcán, Chiriqui Prov., 4 ♀ on *Pharomachrus mocino costaricensis* (A. Wetmore); this bird also harbored 2 *Ornithoctona fusciventris.* — COLOMBIA: Belén, Dept. Huila, 6400 ft., on *Trogon p. personatus* (M.A. Carriker, Jr.).

(p. 241) Additional specimen examined of *Stilbometopa impressa.* CALIFORNIA: Jacumba, San Diego Co., Oct. 23 (A.D. Atnip and R.J. Symonton).

(p. 247) Additional specimen examined of *Stilbometopa podopostyla:* BRITISH HONDURAS: Gallon Jug, on *Leptotila* sp., 1 ♀ with a Mallophagan attached to the under side near outer apex of right coxa; first case of phoresy of lice reported for *S. podopostyla* (S.M. Russell).

(p. 252) Additional specimens examined of *Stilbometopa fulvifrons.* ISLE OF PINES: Pasodita, 2 ♀ on *Saurothera merlini decolor,* Oct. 21 (G.E. Watson III).

Add to list of hosts under Cuculiformes: *Saurothera merlini decolor* (1). This raises the number of known native host species to 8.

(p. 276) Additional specimens examined of *Lynchia americana* (Leach). MASSACHUSETTS: Brookline, on *Accipiter striatus velox* (G.A. Reagh). — ARGENTINA: Río del Valle, Depto. Anta, Prov. Salta, on *Pulsatrix perspicillata boliviana* (S. Pierotti). — BRAZIL: Nova Teutonia near Itá, State Santa Catharina, on *Glaucidium b. brasilianum* (F. Plaumann).

(p. 305) Additional specimen examined of *Lynchia latifacies.* COLOMBIA: La Capilla, Dept. Cauca, 6100 ft., 1 ♀ on *Piaya cayana nigricrissa* (M.A. Carriker, Jr.). This interesting record extends the range of the species to Colombia and adds a second species of Cuculiformes to the host list. Most probably *L. latifacies* will be found eventually to occur over most of tropical South America.

(p. 306) Additional specimens examined of *Lynchia angustifrons* (van der Wulp). BRITISH HONDURAS: Gallon Jug, on 2 *Ciccaba virgata centralis* and on *Hypomorphnus urubitinga ridgwayi* (♂ fly with a mite affixed to left side of tip of abdomen) (S.M. Russell). — NICARAGUA: Musuwas, Upper Waspue River, on *Ramphastos s. sulfuratus* (B. Malkin). — COLOMBIA: La Capilla, Depto. Cauca, 6100 ft., on *Capella nobilis* (M.A. Carriker, Jr.). — BRAZIL: Nova Teutonia, State Santa Catharina, on *Glaucidium b. brasilianum* and on *Circus cinereus,* 2 ♀, both carrying Mallophaga fixed by the mandibles to the sides of the abdomen, 1 on one fly, 5 on the other; first case of phoresy of lice reported for *L. angstifrons* (F. Plaumann). — *L. angustifrons* was also taken by S.M. Russell at Gallon Jug, BRITISH HONDURAS, on *Herpetotheres cachinnans chapmani.*

(p. 308) Add to list of Neotropical hosts: Charadriiformes: *Capella nobilis* (1); Falconiformes: *Circus cinereus* (1); *Herpetotheres cachinnans chapmani* (1).

(pp. 311–312) Additional specimens examined of *Lynchia wolcotti.* BRAZIL: Nova Teutonia, Itá, State Santa Catharina, on *Buteo m. magnirostris* (2 ♀, each carrying mite clusters at tip of abdomen) and *Glaucidium b. brasilianum* (F. Plaumann). — BOLIVIA: Ipirana, South Yungas, 7 flies on *Rhinoptynx c. clamator,* and 9 flies on *Tyto alba tuidara* (Kunzel and Niethammer). — Also taken by F. Plaumann at Nova Teutonia, BRAZIL, on *Asio flammeus suinda.*

(p. 313) Add to list of known hosts, under Falconiformes: *Buteo m. magnirostris* (1). Under Strigiformes: *Glaucidium b. brasilianum* (1); *Rhinoptynx c. clamator* (1); *Tyto alba tuidara* (1); *Asio flammeus suinda* (1).

(p. 316) Delete in the bibliography the entries of *Olfersia dukei* Austen, *Lynchia dukei* J. Bequaert, and *Ornithomyia nigricans* Johnson, which all refer to the African *Lynchia dukei* Austen, now recognized as specifically distinct from the New World *Lynchia nigra.*

(p. 320) The distribution as given for Africa refers to *L. dukei* Austen, which is specifically distinct from the New World *L. nigra.*

(p. 322) The African hosts are those of *L. dukei* Austen.

(pp. 323 and 329) The African *L. dukei* Austen must be regarded as a distinct species. It differs in both sexes from the American *L. nigra* in having on the dorsum of the abdomen a median sclerite placed immediately behind the basal fused laterotergites. This sclerite is usually hidden under the hind margin of the laterotergites in dry, pinned specimens.

(pp. 332–337) Additional specimens examined of *Lynchia albipennis.* ILLINOIS: 3 miles S.W. of Hull, Pike Co., ♀ on *Botaurus lentiginosus,* April 19 (P.W. Parmalee). — CUBA: Batabano, Prov. Havana, on *Nyctanassa v. violacea* (G.E. Watson, III). — BRITISH HONDURAS: Hill Bank, on *Jabiru mycteria* (S.M. Russell). — ARGENTINA: Laguna Vaca Perdida, 50 Kilom. from Ing. Juarez, Prov. Formosa, 4 ♀ and 6 ♂ on *Tigrisoma lineatum marmoratum,* June 16 (S. Pierotti).

(p. 339) Add to list of Neotropical hosts under Ciconiiformes: *Jabiru mycteria* (1).

(p. 350) Additional specimens examined of *Lynchia hirsuta.* NEVADA: O'Neil Basin, northern Elko Co., flies on several *Centrocercus urophasianus* (G.W. Gullion). — U.S.N.M.

(p. 355) Additional specimens examined of *Lynchia holoptera.* COLOMBIA: La Candela, Dept. Huila, 11 flies (9 ♀ and 2 ♂) on *Thamnophilus unicolor grandior,* May 17, 1952 (M.A. Carriker, Jr.).

(p. 356) Add to list of known hosts under Passeriformes: *Thamnophilus unicolor grandior* (1); the heavy infestation of this bird suggests that some of the Formicariidae might be true breeding hosts of *L. holoptera.*

All the flies taken on *T. unicolor grandior* at La Candela were infested with Laboulbeniales, thus adding one more host species for these fungi. According to Dr. R.K. Benjamin, these belong to a peculiar species of *Trenomyces.*

The undescribed male of *L. holoptera* agrees in most details with the female. The relative size, shape and vestiture of the small antero-median sclerite and of the large preänal sclerite on the dorsum of the abdomen are about the same; and I see no appreciable difference in the shape of the head, the relative width of the interocular face, or other characters of the head. The terminalia are very similar to those of *L. albipennis* (Fig. 63*G*); but I can find no trace of the setigerous rudimentary gonocoxite present in *albipennis.*

(p. 370) Additional specimens examined of *Microlynchia pusilla.* TEXAS: Sonora, Sutton Co., on *Geococcyx californianus,* March 26 (O.G. Babcock). — ARIZONA: 1 mile S. of Agua Caliente Ranch, Pima Co., on *Lophortyx g. gambelii,* June 13 (C.R. Hungerford).

(p. 392) Add to references of *Pseudolynchia canariensis:* MacCreary and Catts, 1954, Univ. Delaware, Agric. Expt. Sta., Bull. **307**, p. 9 (Delaware: Newark, New Castle Co., on domestic pigeon).

(p. 394) Add to references of *Pseudolynchia maura:* Reis, 1952, Doenças das Aves, 2nd Ed., p. 218, fig. 151.

(p. 398) Additional specimen examined of *Pseudolynchia canariensis.* PUERTO RICO: Adjuntas, carrying mites (S. Silvestrini).

(p. 400) Add to paragraph on Bionomics. A ♀ of *P. canariensis* received from the Departamento de Zoologia, São Paulo, is labelled "Monte Alegre, State São Paulo on *Columbigallina t. talpacoti,* Feb. 10, 1943 (Lima Coll.)." If fully reliable, this may be the first positive record of the pigeon-fly from a native American host. At present it should only be regarded as a stray or an accidental occurrence.

(p. 413) Additional specimen examined of *Pseudolynchia brunnea.* CUBA: Las Mercedes, Cienaga de Zapata, Prov. Las Villas, on *Caprimulgus carolinensis,* Oct. 19 (G.E. Watson, III).

(p. 414, line 6 from bottom) For "(about 28° S.)," read "(about 41° S., the approximate latitude of Bariloche, on Lake Nahuel Huapu)."

Accepted, valid names in Roman; new names and main references in **bold face**; synonyms in *italics*; *animals, not Arthropoda; †plants.